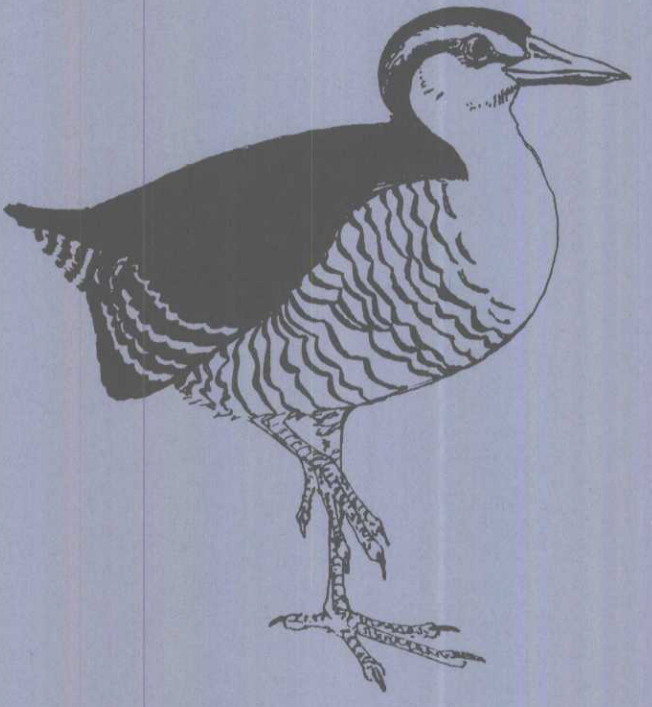
Native Forest Birds of Guam and Rota of the Commonwealth of the Northern Mariana Islands Recovery Plan



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NATIVE FOREST BIRDS OF GUAM AND ROTA OF THE COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS RECOVERY PLAN

Prepared by
Robert E. Beck, Jr.
and
Julie A. Savidge
Division of Aquatic and Wildlife Resources
Department of Agriculture
Government of Guam
Agana, Guam

for
Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

Approved: WILLIAM E. MARTIN
ACTING
Regional Director, U.S. Fish and Wildlife Service

Date: SEP 19 [illegible]

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5430 Grosvenor Lane, Suite 110
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301-492-6403
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EXECUTIVE SUMMARY OF THE RECOVERY PLAN FOR THE NATIVE FOREST BIRDS OF GUAM AND ROTA OF THE COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

Current Status: Of the five species of native forest birds listed as endangered, the Guam broadbill and the Guam bridled white-eye are probably extinct. The Guam rail exists only in captive breeding populations on the island of Guam and in stateside zoos. The Guam Micronesian kingfisher numbered fewer than 50 individuals in the wild in 1984 and has declined drastically since then. It exists mainly as captive breeding populations in stateside zoos. The Mariana crow is the only native Guam forest bird with populations still existing in the wild. In 1985 there were probably less than 100 crows left in the wild on Guam, but the Rota population was estimated to be 1,318 birds and was found throughout the island of Rota.

Habitat Requirements and Limiting Factors: The five listed birds inhabit the various forest types on Guam including limestone forest, broken forest, coconut forest, scrub forest, beach scrub, and agriforest. The Guam rail has the widest ecological distribution and was found over much of Guam in all habitats including open fields except for wetlands. The major cause of extinction for the Guam native forest birds has been predation by the introduced brown tree snake.

Recovery Objective: Downlisting

Recovery Criteria: Control and/or eradicate the brown tree snake on Guam and reestablish wild populations levels for a) Guam rail of 2,000 birds (1,000 in Northern Guam & 1,000 in Southern Guam), b) for Guam Micronesian kingfisher of 1,500 birds (1,000 in Northern Guam & 500 in Southern Guam), c) for Mariana crow of 700 birds on Rota and 700 birds on Guam (500 in Northern Guam & 200 in Southern Guam). No recovery objectives have been set for the Guam broadbill and bridled white-eye other than capturing donor stock to establish captive breeding populations, if possible, since these two species are thought to be extinct.

Actions Needed:

1. Establish captive breeding populations for crow, kingfisher, and rail.
2. Control brown tree snake and other exotic predators and exotic diseases.
3. Reintroduce crow and captive-bred rail & kingfisher to Guam.
4. Conduct research needed to manage forest habitat for birds.
5. Conduct necessary management activities at existing locations on Guam.

Total Estimated Cost of Recovery

Cost: (000's)

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Total
1985	265.0	154.0	15.0	0.0	15.0	449.0
1986	161.5	479.0	13.0	0.0	0.0	653.5
1987	167.5	429.0	22.0	0.0	0.0	618.5
1988	59.0	464.0	49.0	40.0	72.0	684.0
1989	39.0	464.0	22.0	30.0	72.0	627.0
1990	51.0	464.0	49.0	30.0	72.0	666.0
1991	51.0	694.0	49.0	35.0	72.0	901.0
1992	66.0	694.0	93.0	73.0	72.0	998.0
1993	11.0	694.0	87.0	47.0	72.0	911.0
1994	1.0	455.0	94.0	27.0	72.0	649.0
1995	1.0	455.0	13.0	21.0	72.0	562.0
1996	1.0	335.0	13.0	21.0	72.0	442.0
1997	1.0	335.0	13.0	21.0	72.0	442.0
1998	1.0	335.0	13.0	15.0	72.0	436.0
1999	1.0	335.0	13.0	15.0	72.0	436.0
2000	1.0	335.0	13.0	15.0	72.0	436.0
2001	1.0	335.0	13.0	15.0	72.0	436.0
2002	1.0	335.0	13.0	15.0	72.0	436.0
2003	1.0	335.0	13.0	15.0	72.0	436.0
2004	1.0	335.0	82.0	15.0	122.0	555.0
2005	1.0	335.0	69.0	15.0	72.0	492.0
2006	1.0	335.0	69.0	15.0	72.0	492.0
2007	1.0	335.0	69.0	15.0	72.0	492.0
2008	1.0	335.0	13.0	15.0	72.0	436.0
2009	1.0	335.0	13.0	15.0	72.0	436.0
2010	1.0	335.0	13.0	15.0	72.0	436.0
2011	1.0	335.0	13.0	15.0	72.0	436.0
2012	1.0	335.0	13.0	15.0	72.0	436.0
2013	1.0	335.0	13.0	15.0	72.0	436.0
2014	1.0	335.0	13.0	15.0	72.0	436.0
2015	1.0	335.0	13.0	15.0	72.0	436.0
Total Cost	893.0	12,146	1003.0	615.0	2081.0	16,738

Date of Recovery: Downlisting should be initiated in 2015

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RECOVERY PLAN

I. INTRODUCTION

A. Brief Overview

This document is a plan for the recovery of five species of native forest birds listed on the Federal Endangered Species List from Guam and Rota of the Mariana Islands. Included in this recovery plan are the two Guam endemic species, the Guam broadbill (Myiagra freycineti) and Guam rail (Rallus owstoni), and the two Guam endemic subspecies, the Guam Micronesian kingfisher (Halcyon cinnamomina cinnamomina) and Guam bridled white-eye (Zosterops conspicillata conspicillata). The Mariana crow (Corvus kubaryi), which is endemic to Guam and Rota, is also included. Historically, 12 species of forest birds are known from Guam and ten species from Rota (Table 1). One of these species, the Micronesian (La Perouse's) megapode (Megapodius laperouse laperouse), while still found elsewhere in the Northern Mariana Islands, was probably extinct by the 20th century on both Guam and Rota, although uncomfirmed reports still persist from local residents of sightings of the megapode on Rota (Engbring et al. 1986; Wiles et al. 1987; Glass, 1986, pers. comm.). The megapode is not included in this recovery plan.

Presently, on Guam, the entire native forest avifauna (12 species including the extirpated megapode) appears on Guam's endangered species list and seven of these species were also listed on August

Table 1. Present status of native forest birds known historically from Guam and Rota.

Chamorro Name	Species English Name[a]	Scientific Name	Guam	Rota	Status[b]	Range
Sasingat	Micronesian Megapode	Megapodius l. laperouse	X	X	1,2,4	Mariana Islands
Koko	Guam Rail	Rallus owstoni	X		1,2	Guam
Totot	Mariana Fruit-Dove	Ptilinopus roseicapilla	X	X	2	Mariana Islands
Puluman Apaka Puluman Fache	White-throated Ground-Dove	Gallicolumba x. xanthonura	X	X	2	Mariana Islands, Yap
Yayaguak[c]	Vanikoro Swiftlet	Aerodramus vanikorensis bartschi	X	X	1,2	Mariana Islands
Sihek	Guam Micronesian Kingfisher	Halcyon c. cinnamomina	X		1,2	Guam
Sihek	White-collared Kingfisher	Halcyon chloris orii		X		Rota
Aga	Mariana Crow	Corvus kubaryi	X	X	1,2	Guam, Rota
Chichirika	Rufous-fronted Fantail	Rhipidura rufifrons uraniae	X		2,3,7	Guam

Chamorro Name	English Name[a]	Scientific Name	Guam	Rota	Status[b]	Range
Chichirika	Rufous-fronted Fantail	Rhipidura rufifrons mariae		X		Rota
Chuguanguang	Guam Broadbill	Myiagra freycineti	X		1,2,6	Guam
Sali	Micronesian Starling	Aplonis opaca guami	X	X	2	Mariana Islands
Egigi	Cardinal Honeyeater	Myzomela cardinalis saffordi	X	X	2	Mariana Islands
Nossa	Bridled White-eye	Zosterops c. conspicillata	X		1,2,5	Guam
Nossa	Bridled White-eye	Zosterops conspicillata rotensis		X		Rota

a. Common names for endangered species are as listed in Federal Endangered Species List (50 CFR 17.11).
b. Key 1 - Listed on U.S. Endangered Species List.
2 - Listed on Guam Endangered Species List.
3 - Proposed for listing on U.S. Endangered Species List.
4 - Extinct on Guam and possibly extinct on Rota.
5 - The Bridled White-eye has not been seen on Guam since 1983.
6 - The Guam Broadbill has not been seen since 1984.
7 - The Rufous-fronted Fantail has not been seen on Guam since 1984.
c. A separate recovery plan is being developed for this species.

27, 1984, (49 FR 33881-33885) on the U.S. Federal Endangered Species List. Rota has two federally listed (49 FR 33881-33885) endangered forest bird species that are also found on Guam.

B. Location

Guam and Rota are the two southernmost of the Mariana Islands lying at about 14° North and 145° East, and separated by approximately 49 km (Figure 1). To the east lies the Pacific Ocean and to the west the Philippine Sea. Guam is an unincorporated U.S. Territory while Rota is a part of the Commonwealth of the Northern Mariana Islands (CNMI).

Guam is approximately 45 km long and 6-13 km wide with a land area of 550 sq. km. The northern half of Guam is a relatively flat limestone plateau formed over volcanic rock and bounded by steep cliffs. Mountainous southern Guam is mostly of volcanic origin with a maximum elevation of 405 m. The approximate boundary between northern and southern Guam extends from Agana on the west coast of the island to Mangilao on the east side. Fringing reefs surround most of the island (Eldredge 1983).

Rota, approximately 19 km long and 4 to 8 km wide, has a land area of 85 sq. km. It is composed mostly of limestone terrain overlying volcanic formation with a maximum elevation of 491 m. The reef flat that surrounds much of the island is raised limestone (Eldredge 1983).

The vegetation and habitat types on Guam and Rota have been described in detail by Fosberg (1960). Engbring and Ramsey (1984) divided Northern Guam into eight general habitat types, including Primary Limestone Forest, Broken Forest, Coconut Forest, Scrub Forest, Beach Scrub, Open Field, Agriforest, and Urban. Prehistorically, most of the northern limestone area of Guam was

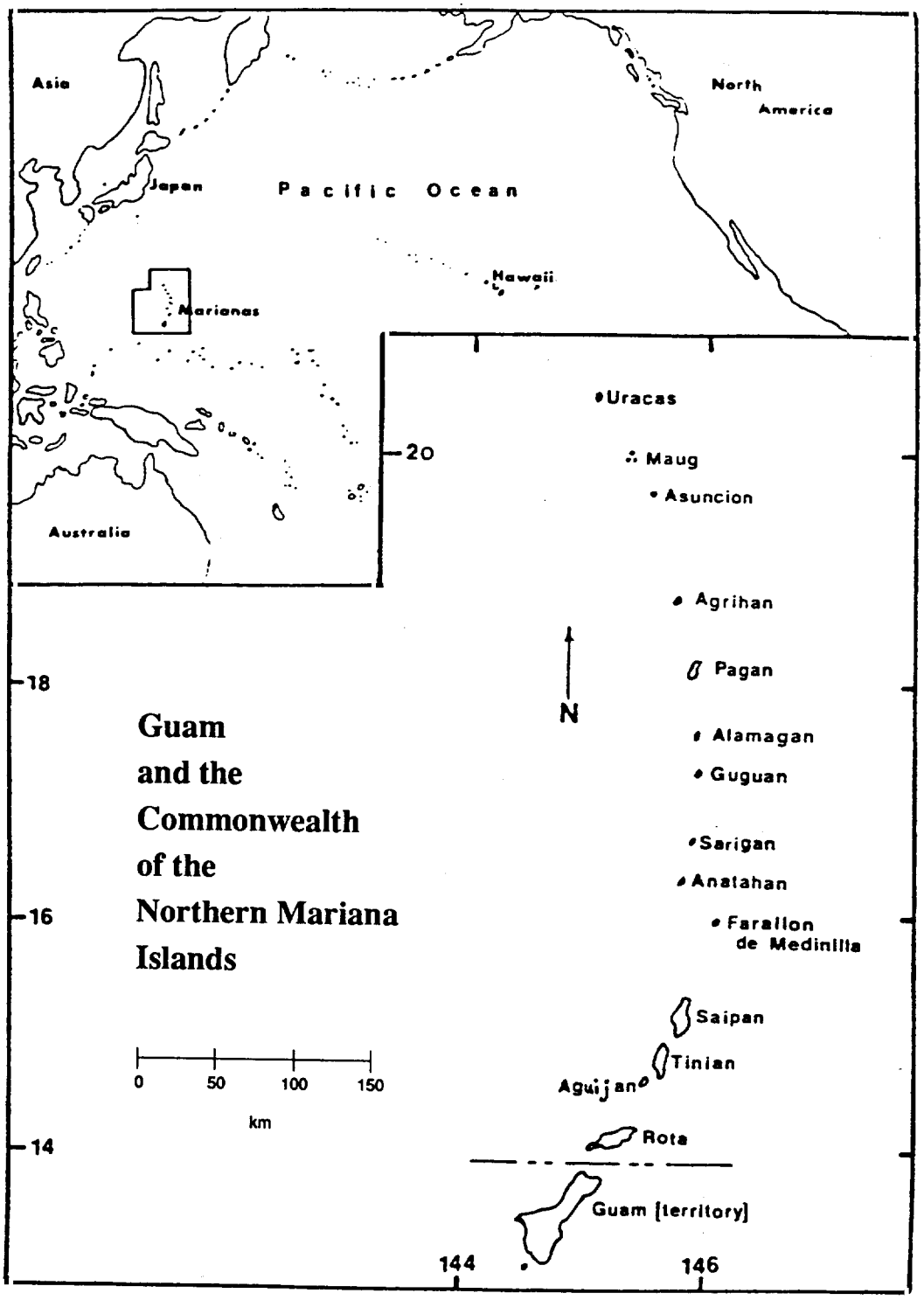

Figure 1. Map of the Mariana Islands.

forested with a diversity of large trees (10-30 m) having a dense canopy. However, a long history of disturbance dating from the original occupation by the Chamorros (2000-4000 yrs. ago), along with the destructive effects of World War II, and subsequent agriculture and urban development, have significantly reduced the acreage of undisturbed PRIMARY LIMESTONE FOREST on Guam. Scattered patches of pristine forest still remain on Guam primarily on the cliff tops and in the relatively inaccessible terrain below cliffs on the northern half of the island.

The southern half of Guam is mostly OPEN FIELDS (i.e. grasslands) and AGRIFOREST (i.e. mosaic of grasslands, forests, and subsistence farms), with patches of BROKEN FOREST overlying areas of limestone and in the ravine valleys. The OPEN FIELDS may have developed as a result of repeated and extensive burning over many years (Fosberg 1960).

Prehistorically, Rota was probably covered almost entirely by a mixed forest. Much of the original forest has been cut, first by the native Chamorros, followed by the agricultural activities of the Japanese, so that while most of the island is now forested, what is left is of medium stature, rather degraded by logging and in places by the effects of past warfare (Fosberg 1960).

Eldredge (1983) summarized the climatic information for Guam and Rota. Both islands have a tropical oceanic climate and are uniformly warm and humid throughout the year with a dry season from January through May and a wet season from July through November. The area is dominated for much of the year by east and northeast tradewinds. The tradewinds weaken during the wet season and may be interrupted by typhoons with winds over 240 km/hr. Mean annual rainfall varies from 200-250 cm on Guam with slightly less on Rota. The average mean temperature on Guam and Rota is 27° C.

C. Species Descriptions

Abundance estimates referred to in Figures 2 to 6 for each species are based largely on parameters in Jenkins (1983) as follows: Abundant: seen or heard on 90-100% of visits to an area; Common: seen or heard on 50-90% of visits; Uncommon: seen or heard on 10 to 50% of visits; and Rare: seen or heard on less than 10% of visits. For location of essential habitat on Guam refer to Figure 7. For location of sites mentioned in the text refer to the map of northern Guam in Recovery Narrative (Figure 8).

KOKO OR GUAM RAIL (Rallus owstoni)

Distinguishing Characteristics -- Head, neck, and eye stripe are brown with feathers on sides of neck tipped with rufous; throat and upper breast near gray; short wings are dark with brownish spots and barred with white; lower breast, abdomen, under tail coverts, and tail blackish with white barrings; bill gray; long legs and dark feet brown; iris red. Female is similar but slightly smaller than male (Baker 1951).

Past and Present Status and Distribution -- Rallus owstoni is endemic to Guam, and it was formerly distributed island-wide. Roadside censuses begun in 1961 by the Guam Division of Aquatic and Wildlife Resources (GDAWR) have documented the decline of the Guam rail (Anon. 1979). The rail disappeared from southern Guam in the early 1970's (Jenkins 1979). A United States Fish and Wildlife Service (USFWS) survey done in 1981 found the rail only in northern Guam with the largest concentration on Andersen Air Force Base (AAFB) (Engbring and Ramsey 1984). A conservative estimate of the population in 1981 was approximately 2,300 birds (Engbring and Ramsey 1984). In 1983 the GDAWR found the rail to be confined to two small discontinuous populations: one in Northwest Field, and the other on the flightline of AAFB (Figure

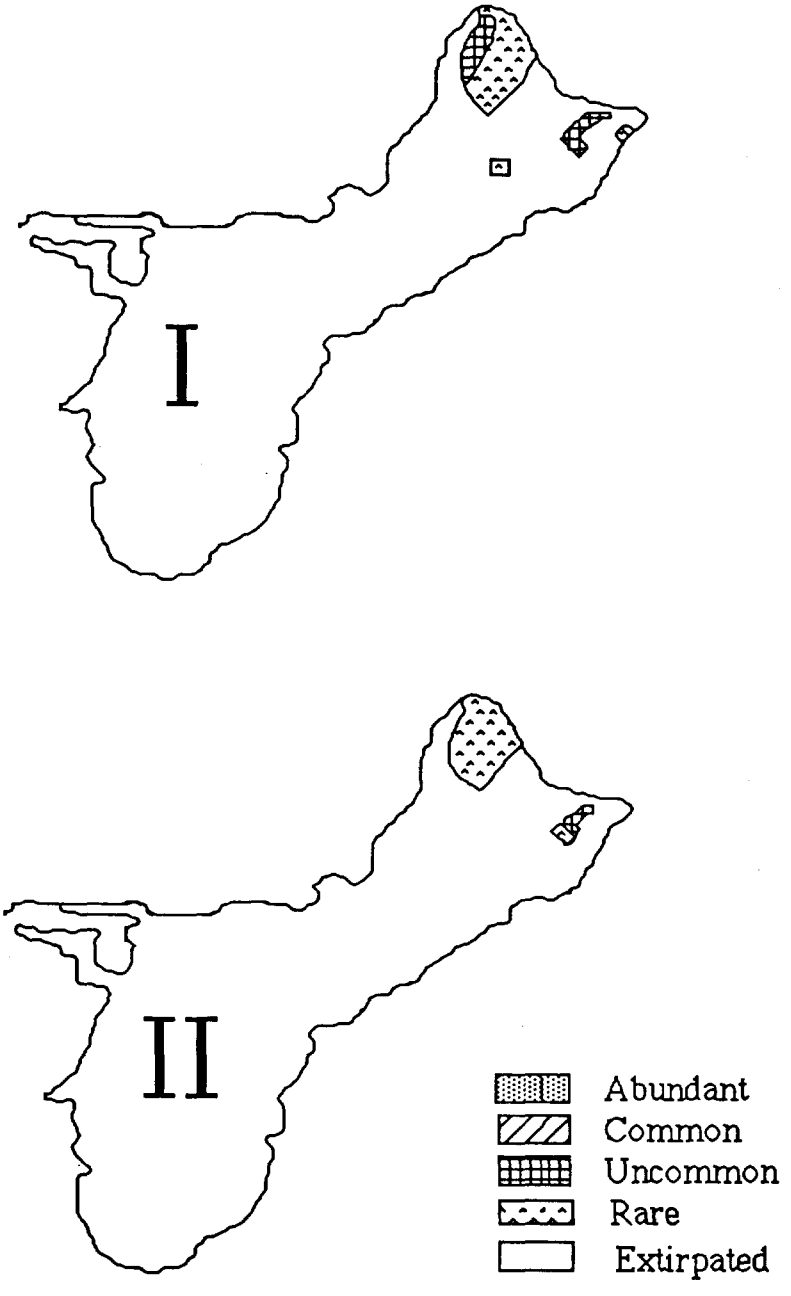

Figure 2 - Distribution of the Guam Rail in January 1983 (Aguon 1983) Map I, and in March 1984 (Beck 1984a) Map II.

2, Map I; Aguon 1983). A repeat of the above survey in 1984 found the rail was extremely rare in Northwest Field, and the last viable population of Guam rails was restricted to a 28-ha area inside the flightline at AAFB (Figure 2, Map II; Beck 1984a). By July 1985, only one rail could be located in the flightline area (Beck 1985, unpubl. data).

Habitat and Feeding Behavior -- The Guam rail was distributed over much of Guam in all habitats except wetlands, although Jenkins (1979) considered both savanna and mature mixed forest marginal habitat. As Guam was probably mostly limestone forest before the arrival of man (Fosberg 1960), the rail may have been more common after much of the mature forest had been converted to scrubby second-growth or mixed forest (Engbring and Ramsey 1984). Rallus owstoni, while an omnivorous feeder, appears to prefer animal over vegetable food (Jenkins 1979). It is known to eat gastropods, skinks, geckos, insects, and carrion as well as seeds and palm leaves (Jenkins 1979).

Breeding Biology -- The Guam rail is a year-round ground nester laying 2-4 eggs with both parents sharing in the construction of a shallow nest of leaves and grass (Jenkins 1979). Incubation is 21 days (Beck 1985, unpubl. data) with both sexes sharing in the nesting duties. In captivity, rails reproduced for the first time at 5 months of age and in at least one case, laid a second clutch while still feeding 3-week old chicks (Beck 1985, unpubl. data). Perez (1969) suggested a peak breeding period during the rainy season (May-Oct). The extremely precocial young hatch asynchronously and leave the nest within 24 hours of hatching to forage with the aid of their parents (Jenkins 1979).

SIHEK OR GUAM MICRONESIAN KINGFISHER (Halcyon cinnamomina cinnamomina)

Distinguishing Characteristics -- The Micronesian kingfisher is

sexually dimorphic; the male has rusty brown head, neck, upper back and underparts; a narrow black line extending around nape; orbital ring black; lower back, lesser wing-coverts and scapular greenish blue; blue tail; feet dark brown; bill black, base of mandible paler; iris dark brown. The adult female is similar to the adult male, but chin, throat, and underparts are white. The immature resembles the adult, but brown of crown mixed with greenish-blue, the chin and throat are whitish (more buff in the male) (Baker 1951).

Past and Present Status and Distribution -- This subspecies is endemic to Guam. Related subspecies occur on Palau (H. c. pelewensis) and Pohnpei (H. c. reichenbachii) in the Caroline Islands. Halcyon chloris occurs on Rota and in the rest of the Marianas. Historically the Micronesian kingfisher occurred island-wide in all habitats on Guam except in pure savanna and wetlands (Marshall 1949, Baker 1951, Tub 1966, Jenkins 1983). It was last reported from southern Guam in the 1970's (GDAWR 1985, unpubl. data). Jenkins (1983) reported that the kingfisher was still found over much of northern Guam in 1978-79 (Figure 3). A USFWS survey conducted in 1981 estimated the total population remaining in northern Guam to be 3,023 (Engbring and Ramsey 1984). More recent limited surveys indicated the kingfisher is restricted to the Northwest Field and Conventional Weapons Storage Area of Andersen Air Force Base (Figure 3) with a population estimate of probably less than 50 individuals (Beck 1984a; Marshall and Beck 1985, unpubl. data).

Habitat and Feeding Behavior -- The Micronesian kingfisher on Guam nests and feeds primarily in mature limestone forest and mixed woodland and second-growth stands, and to a lesser degree, in the scrub forests of the northern plateau (Jenkins 1983). It was also found in coastal strand vegetation containing coconut palm (Cocos nucifera) as well as riparian habitat.

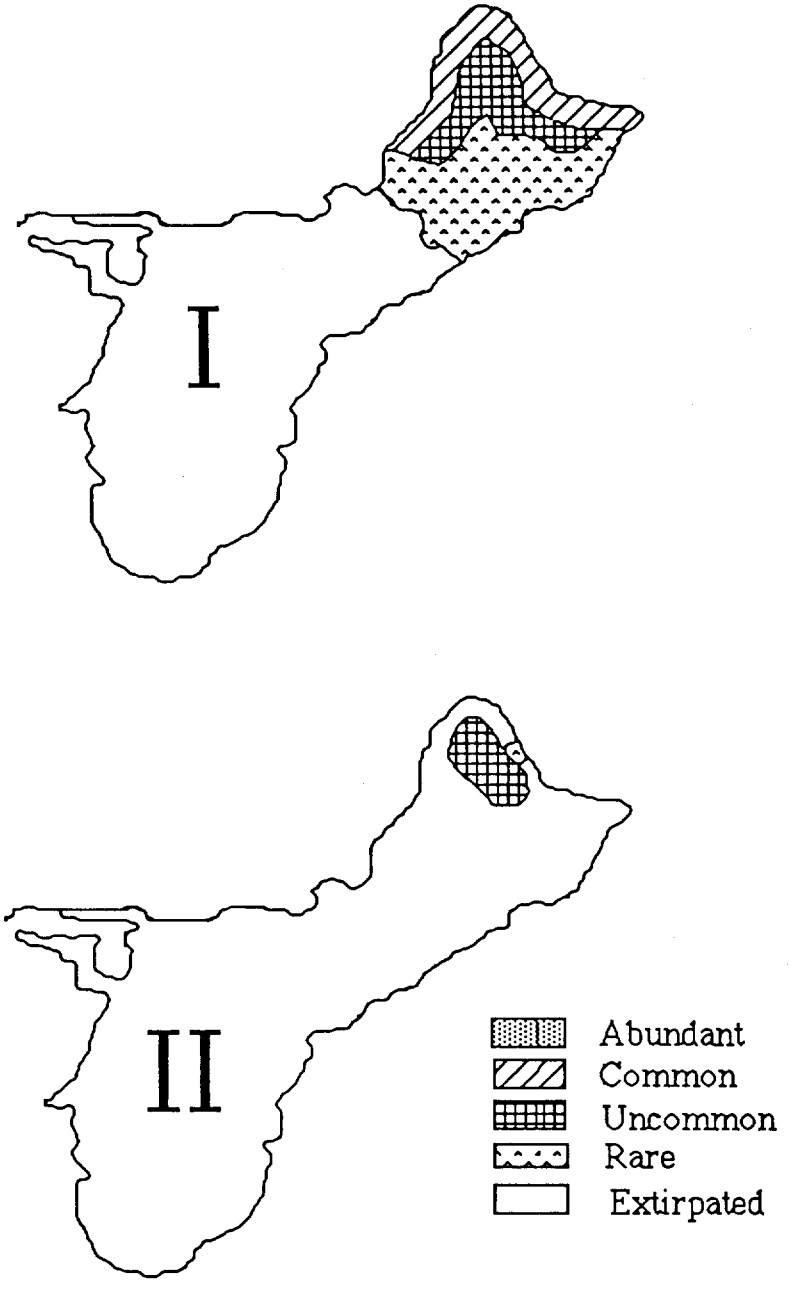

Figure 3 - Micronesian Kingfisher distribution on Guam. Map I is for 1978-1979 (adapted from Jenkins 1983) and Map II is for 1985 (Marshall and Beck, unpubl. data).

The Micronesian kingfisher is one of the few native birds that perches on power lines or telephone poles adjacent to forest areas (Jenkins 1983).

Halcyon c. cinnamomina feeds entirely on animal matter including lizards (Seale 1901), skinks and geckos (Baker 1951), insects (Marshall 1949), annelids (Marshall 1949) and small crustaceans (Jenkins 1983). It feeds mainly from the ground (Jenkins 1983). In captivity, the kingfisher has taken geckos, anoles, newly born mice, crickets, wax moth larvae, and mealworms (Beck 1985, unpubl. data and Shelton 1986). The kingfisher is a very deliberate forager, typically perching motionless on exposed perches in large trees that have good views of the ground below from which it swoops down to capture its prey, often calling (Jenkins 1983). When successful, it returns to its perch, prey in its bill, and beats the prey side to side on the branch to stun it or kill it before swallowing it whole (Jenkins 1983).

Breeding Biology -- Nesting activity appears concentrated from December to July (Marshall 1949, Baker 1951, Jenkins 1983). Average clutch size consists of 2 eggs (Jenkins 1983). Both sexes participate in the excavation of the nest cavity in very soft rotten trees (Jenkins 1983). While Jenkins (1983) reported that mated pairs "drill" nest cavities primarily from January through July, nest cavity excavation has more recently been observed during the entire year (Beck 1985, unpubl. data; Marshall and Beck 1985, unpubl. data). Some cavities are apparently never used for nesting and may function primarily in the formation and maintenance of the pair bond and in courtship (Jenkins 1983; Beck 1985, unpubl. data). Beck and Marshall have recently conducted extensive field investigations on the breeding biology of the Micronesian kingfisher. Much of the following information is summarized from their unpublished data.

The Micronesian kingfisher requires mature forest containing large old rotting trees such as Pisonia grandis, Artocarpus mariannensis, and Cocos nucifera in which it builds its cavity nest. Baker (1951) also reported a nest in a Ficus sp. tree. Jenkins (1983) reported excavations attempted on telephone poles or other wooden structures. Experience in captive breeding of this bird at several stateside zoos has demonstrated the importance of extremely rotten, large diameter trees to serve as nest cavity sites for this species (Shelton 1986; Derrickson 1987, unpubl. data, Shepard 1987, unpubl. data). P. grandis, is preferred by the Micronesian kingfisher when available. P. grandis which has "soft wood," will survive for many years with large rotten branches that were damaged during typhoons while the remainder of the tree is quite viable. These soft rotting branches serve as excellent nest cavity sites for the kingfisher.

Jenkins (1983) reports that pairs may also use other available cavities such as broken hollow limbs. However, during 3 years of kingfisher capture efforts on Guam from 1983-86 and during a 5-month study in 1985, kingfishers were only observed using cavities that they had excavated themselves.

Both sexes incubate eggs, and brood and feed young (Jenkins 1983). The female incubates at night. Two clutches reported by Baker (1951) and one reported by GDAWR staff (1985, unpubl. data) contained two eggs. Marshall and Beck observed one nest with one egg. One brood observed (GDAWR 1985, unpubl. data) had two young while another produced a single fledgling. The number of clutches produced per year is unknown, but observations during 1980-81 suggest some pairs produce two clutches per season (GDAWR 1985, unpubl. data).

Both sexes brood and feed the altricial young and participate in feeding of the fledglings (Jenkins 1983). The length of time of development of the young from hatching to independence is unknown.

AGA OR MARIANA CROW (Corvus kubaryi)

Distinguishing characteristics -- Adult: A small, black crow with a slight greenish-black gloss on head; back, wings, and tail with bluish-black gloss; underparts with dull, greenish-black gloss; bill and feet black; iris dark brown. Female is smaller. Immature: Resembles adult, but feathers with less gloss; wings and tail browner (Baker 1951).

Past and Present Status and Distribution -- Endemic to Guam and Rota, the Mariana crow is the only corvid in Micronesia. Baker (1951) found the crow common and confined to forested areas and coconut plantations on Guam and Rota after World War II in 1945. They were not found in areas of human habitation. On Guam the last sightings of the crow in the south occurred in the mid-1960's, and they have been absent from central Guam since the mid-1970's (Jenkins 1983). A USFWS survey in 1981 estimated a population of 357 crows. These were distributed primarily over the northern cliffline forests (Engbring and Ramsey 1984). Presently, crows on Guam are found in forest areas from Ritidian Pt. to Anao along the northern cliffline, in Northwest Field, and in the Conventional Weapons Storage Areas (Figure 4, Map II). In 1985 it was estimated that there were less than 100 birds left in the wild (Michael, and Beck 1985, unpubl. data). In 1976 on Rota, Pratt et al. (1979) found the crow to be common and widely distributed. In 1979 Jenkins and Aguon (1981) found crows on 16 percent of their station counts at Rota and considered it uncommon. Based on limited sampling, they estimated fewer than 300 crows on both Guam and Rota and recommended that it be listed as endangered throughout its range. The island-wide USFWS survey in 1982 found crows distributed throughout the island of Rota and estimated the total population on Rota at 1,318 birds (Engbring et al. 1986). Observations in 1984 indicated that nothing had changed to affect the crow population on Rota since the 1982

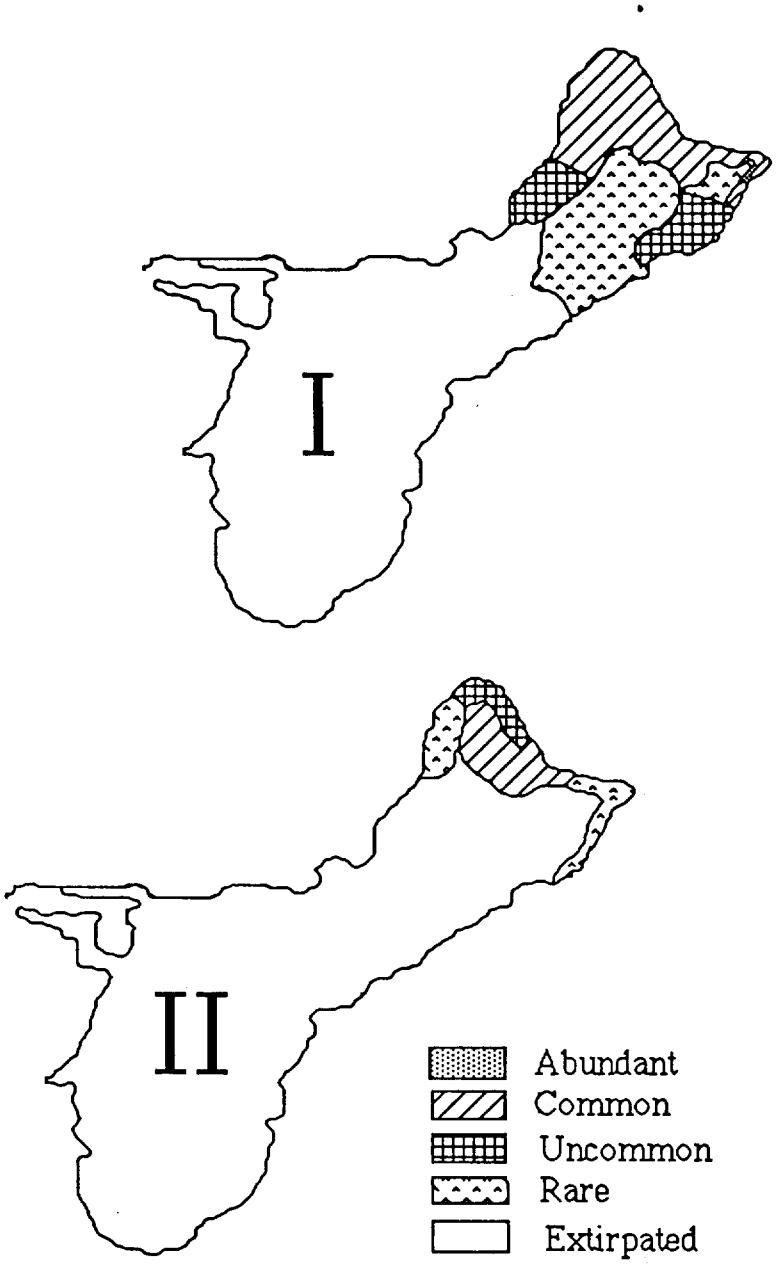

Figure 4 -Distribution and abundance of the Mariana Crow on Guam. Map I is for 1978-1979 (adapted from Jenkins 1983). Map II is for 1985 (Wiles and Beck, Unpubl. data).

survey (Pratt 1985).

Habitat and Feeding Behavior -- The Mariana crow's preference for mature native forest on Guam has been noted by several authors (Seale 1901, Strophlet 1945, Marshall 1949). Baker (1951) found the crow confined to coconut plantations and forest areas and only infrequently found it in areas of human habitation. The GDAWR in 1983 (Wiles 1985, unpubl. data) noted the presence of the crow in mature forest (native, mixed woodland and second growth) on AAFB, and its absence in areas of human habitation such as base housing, active airfield areas, and other locations around buildings with high human usage.

Tomback (1986), during a 2-week study on Guam and Rota in July 1980, listed 13 plant species used by the crow for foraging and other activities. Eleven of these species were native and typical of limestone forest and coastal strand. The two exceptions were Leucaena leucacephala and Mangifera indica, both of which are introduced.

During a study of the crow in the fall of 1985 (Michael and Beck 1987, unpubl. data), the crow was found restricted to mature forest in Northwest Field and Conventional Weapons Storage Area on AAFB, primarily using emergent trees such as Ficus prolixa and Elaeocarpus sphaericus to view and defend their territory and in which to build nests. Two actively breeding crow pairs were found during this study. One built a nest and unsuccessfully incubated eggs high in an emergent Ficus prolixa tree in an area of mature mixed woodland-native forest on Northwest Field, AAFB. The second pair unsuccessfully incubated eggs in at least 10 successive nests in at least 6 different emergent Elaeocarpus sphaericus trees in native forest at Conventional Weapons Storage area on AAFB over a 6-month period.

Both Baker (1951) and Jenkins (1983) reported crow nests in Ficus

prolixa. Tomback (1986) reports a crow nest in Hernandia nymphaeifolia.

Habitat usage of the Mariana crow on Rota has been little studied, but Baker (1951), Pratt et al. (1979), and Engbring et al. (1986) found the crow primarily in forest habitat. Baker (1951) found the habitat usage of the crow on Rota to be similar to that he observed on Guam. Tomback (1986) found the crow on Rota only in native limestone forest and coastal strand vegetation.

The Mariana crow is an omnivorous, opportunistic feeder that is known to feed on insects, lizards, hermit crabs, fruits, seeds, flowers, and according to Jenkins (1983), occasionally foliage and bark. Tomback (1986) observed crows searching leaves and bark, presumably for insects. During a study on Guam in the fall of 1985, the Mariana crow was observed feeding primarily on animal matter and was not seen feeding on bark or foliage although much time was spent there by the crow searching for insects (Michael 1986). Fledglings and adults on Rota in 1986 were observed tearing up but not eating bark and dead leaves in search of insects (Beck 1987, unpubl. data). The crow forages on the ground as well as in the forest canopy (Jenkins 1983; Savidge 1985, unpubl. data). The Mariana crow also apparently feeds on other birds eggs (Beaty 1967).

Little is known of the reproductive biology of the Mariana crow. It apparently nests year-round (Jenkins 1983; Michael, and Beck 1985, unpubl. data). Clutch and brood sizes are not well known but Jenkins (1983) observed a pair of crows with two fledglings and a single adult with one fledgling. One nest was observed on Guam containing one egg in October 1985 (Michael 1986). On Rota one adult pair was observed with two fledglings and another pair with one fledgling in March, 1986 (Beck 1987, unpubl. data).

A study in the fall of 1985 (Michael 1986) found that the crow

builds its stick nest high in emergent Ficus or Elaeocarpus trees in mature forest on horizontal forking 5-8 cm branches on the upper, outer part of trees strong enough to support the large structure. (The 40 x 30 x 10 cm nest had an inner cup measuring 13 x 13 x 6 cm. The outer part of the nest was composed of dead Elaeocarpus twigs. The inner cup was made primarily of fibers from Cocos nucifera and Pandanus spp. leaves (Michael 1986)).

He found nest site locations ranged from 15 feet to 55 feet high. Both sexes participated in all aspects of the construction of the nest. The female did all of the incubating at night and most of the incubation during the day with the male relieving her for only short periods of 5-10 minutes at a time. Even though the female left the nest during the day to forage, the male fed the female on the nest several times a day. Incubation time is unknown but a crow pair incubated for as long as 18 days on two occasions before abandoning the nest due to predation presumably from the brown tree snake.

The time required for the development of the altricial young is unknown. Both parents participate in the care of the young (Jenkins 1983). Apparently an extensive learning period is necessary for the young (Jenkins 1983), with fledglings closely following their parents, begging for food and learning the foraging pattern of their parents (Jenkins 1983; Beck 1985, unpubl. data). Both parents defend the nest site, although the male plays a greater role than the female (Michael, and Beck 1985, unpubl. data). The duration of the pair bond is unknown.

CHUGUANGUANG OR GUAM BROADBILL (Myiagra freycineti)

Distinguishing Characteristics -- A small old world flycatcher with head and neck bluish with a metallic luster; back and upper wing coverts near green-blue; rump grayer than back; chin and throat white; breast light cinnamon, tail bluish-slate; bill and

feet black; iris dark brown. Adult female: More gray-brown above with less of a metallic luster. Immature: Resembles adult but more brown and less blue on back; underparts generally more buffy than adult (Marshall 1949, Baker 1951).

Past and Present Status and Distribution -- This species is a member of the family Muscicapidae that is endemic to Guam. Closely related congeners (considered to be the same species by some taxonomists) occur in Truk (M. oceanica), Palau (M. erythrops) and Pohnpei (M. pluto). The Guam broadbill was apparently known historically from all habitats except savanna (Jenkins 1983). Jenkins (1983) reported that in 1979 it was restricted to the mature limestone forest of the relatively undisturbed northern cliffline and was rare in the mixed woodlands and second growth of the extreme northwestern portion of the northern plateau (Figure 5). A USFWS survey in 1981 (Engbring and Ramsey 1984) estimated 460 broadbills remaining in extreme northern Guam. In 1983 broadbills were primarily restricted to Pajon Basin (150 ha) (Beck 1985, unpubl. data).

October 1983, was the last date that broadbills were seen in the Pajon Basin area (Beck 1984a). The last two sightings of the broadbill on Guam were apparently transient individual males. One was seen by Beck and Eugene Morton, Smithsonian Institution, at Northwest Field in March 1984, and the other by Philip Bruner, Brigham Young University Hawaii Campus, in an area adjacent to the Navy golf course in Barrigada in August 1984 (Beck 1984a). This species may now be extinct.

Habitat and Feeding Behavior -- Formerly, the Guam broadbill was found in all habitats with the exception of southern savannas. It is apparently entirely insectivorous and feeds both by gleaning insects from twigs and foliage as well as hawking insects from the air (Jenkins 1983).

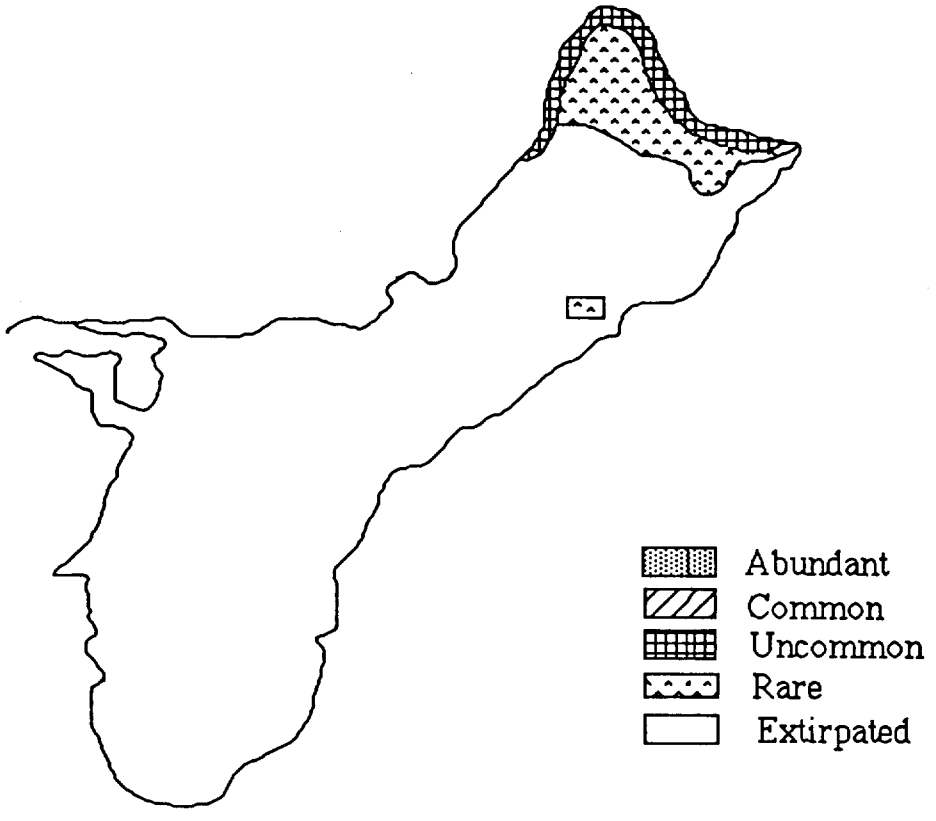

Figure 5 - Distribution and abundance of the Guam Broadbill in 1978-1979 (adapted from Jenkins 1983).

Breeding Biology -- The Guam broadbill nests year-round with one or two eggs per clutch (Jenkins 1983; Beck 1985, unpubl. data). Nests of this species are firmly constructed, usually in the fork of branches of middle-sized trees or shrubs (Jenkins 1983). The number of clutches per year is unknown although one pair raised three broods in 10 months during 1980-81. Both sexes incubate eggs and brood young (Jenkins 1983).

NOSSA OR BRIDLED WHITE-EYE (Zosterops c. conspicillata)
Distinguishing Characteristics -- Adult Male: Upper parts light green; orbital ring broad and white; chin and throat yellowish-white; breast and abdomen dingy yellow; wing and tail feathers dark brown with greenish-yellow edges; legs and feet dark olive-grey; iris light amber. Adult female: Underparts lighter. Immature: Underparts paler yellow and upper mandible light yellowish-brown (Baker 1951, Marshall 1949).

Past and Present Status and Distribution -- The subspecies is endemic to Guam (Baker 1951). This Micronesian species is also found in Palau, Yap, Truk and Pohnpei. Related subspecies in the Mariana Islands include Z. c. saypani on Saipan and Tinian and Z. c.rotensis on Rota. The distribution of the Guam subspecies was formerly island-wide (Jenkins 1983). By 1945 there were still a few white-eyes in southern Guam (Strophlet 1946). White-eyes were last recorded in central Guam in 1961 (GDAWR 1985, unpubl. data).

Figure 6 illustrates the distribution and abundance of this species in 1978-79. A USFWS survey in 1981 (Engbring and Ramsey 1984) estimated that 2,220 white-eyes remained, but they occupied only 2% of their known historical range in northern Guam and none of their former range in central and southern Guam. In 1982 white-eyes were restricted to Pajon Basin (Figure 6) at Ritidian Point in extreme northern Guam (Beck). A survey by staff of the GDAWR in the spring of 1983 indicated there were probably fewer

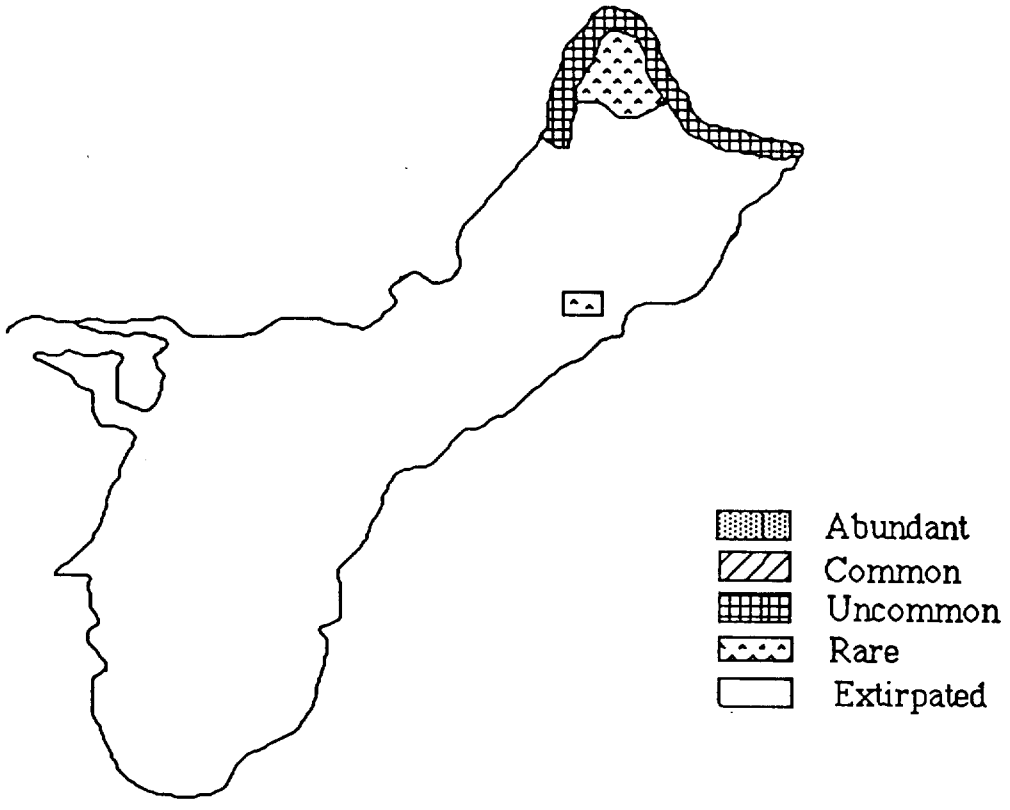

Figure 6 - Distribution and abundance of the Bridled White-eye in 1978-1979 (adapted from Jenkins 1983).

than 50 white-eyes left in Pajon Basin (Beck 1985, unpubl. data). The last family group was observed with a fledgling in the fall of 1982 at Pajon Basin (Beck 1984a). The last observation of a bridled white-eye was in June 1983 in Pajon Basin (Beck 1984a), and this subspecies may now be extinct.

Habitat and Feeding Behavior -- The bridled white-eye has been found in the past in most available habitats on Guam including mature, pristine limestone forest (Baker 1951), scrubby second-growth (Tubb 1966), grasslands and foothills of southern and central Guam (Strophet 1946), beach strand (King 1962), wetlands of Agana swamp, and mixed woodlands and second-growth of the northern plateau (Jenkins 1983). It feeds primarily on insects, apparently taking little fruit or nectar (Jenkins 1983).

Breeding Biology -- The white-eye is an active flocking bird that appears to be non-territorial even when nesting, as evidenced by its lack of responses to tape-recorded playback of its call (Beck, Jenkins 1983). It apparently nests year-round (Marshall 1949, Jenkins 1983), laying 2-3 eggs per clutch (Hartert 1898). The number of clutches per year is unknown. Relatively little is known of the nesting habits of this species on Guam.

D. Possible Causes of Decline in Avifauna

Habitat Degradation and Destruction -- Little is known about Guam's vegetation before World War II. It is probable that all limestone areas were forested prior to 1940 (Fosberg 1960). During the war large areas were cleared and some habitat was destroyed during heavy fighting (Fosberg 1960). Since 1945 there has been an increase of weedy species, especially tangentangen (Leucaena leucocephala), in open or cleared areas. Nonetheless, there appears to be substantial native habitat remaining in both southern and northern Guam (Savidge 1984). Additionally, major

habitat disruptions have also occurred on Tinian and Saipan, yet forest bird populations have remained stable, and some forest birds (for example, bridled white-eyes, rufous-fronted fantails, and cardinal honeyeaters) are frequently observed in patches of tangentangen on Tinian and Saipan (Savidge, and Beck).

Although habitat degradation does not appear responsible for the major decline of the avifauna, it may have caused additional stress on the forest birds. It is not clear how the substantial changes in habitat have ultimately affected the populations of Guam's native forest birds or, perhaps more importantly, how this factor may have interacted with other limiting factors. The specific habitat requirements of the birds on Guam are not well known, however, limited information suggests that the crow and possibly the kingfisher may require undisturbed mature forests (Seale 1901; Strophet 1946; Marshall 1949; Baker 1951; Marshall; Michael, and Beck 1985, unpubl. data). Therefore, changes in habitat conditions may be expected to have a greater effect on these species than on the other endangered forest birds. As Guam becomes more developed, habitat may become a limiting factor.

Typhoons -- Two major typhoons struck Guam during the avian decline. Typhoon Karen (1961) had winds estimated at 333 kph and Typhoon Pamela (1976) had gusts up to 256 kph (Tenorio 1979). Karen was the second most intense and Pamela the third most intense typhoon to hit Guam since 1900. After Pamela, many large trees had been blown down or badly damaged and sightings of all avian species were less frequent (Drahos 1977). However, within the past 15 years, two typhoons (Jean in 1968 and Pamela in 1976) have also caused major destruction on Saipan, where native forest birds remain abundant. Birds in the Mariana Islands have long endured typhoons, but major typhoons in concert with low population numbers and other factors could severely affect endangered populations.

Competition

Seven avian species have been introduced to Guam. The only species that could be considered a potential competitor with native forest birds is the black drongo (Dicrurus macrocercus), the only introduced passerine found in or near forested habitat. This bird is an aggressive and adaptable species first sighted on Guam in 1960 (GDAWR 1985, unpubl. data). However, Maben (1982) concluded that due to differences in habitat use and foraging techniques the black drongo was not competing with native birds on Guam.

Pesticides -- Pesticides have been used extensively in the past for agriculture and vector control on Guam. Following World War II and up until 1970, DDT and other insecticides were applied as often as once a week by the military (Baker 1946, Maben 1980, Anderson 1981). Liberal use of malathion to control insect pests has also occurred over the last few decades. However, an intensive pesticide survey conducted by Patuxent Wildlife Research Center (USFWS) in 1981 concluded that neither past nor present use of pesticides on Guam appear to be responsible for the continuing declines in the island's native bird populations (Grue et al. 1985).

Human Exploitation -- Hunting of adults and collecting of eggs may have contributed to the demise of the megapode on Guam before the 1900's (Baker 1951). Likewise, several other native forest birds, including the Guam rail, have also been hunted by Guamanians. According to Guam law, the Micronesian kingfisher and Mariana crow were largely unprotected up until 1981 (Penal Code of Guam 1922, 1947, 1953; Guam P.L. 6-87, 1962; Guam P.L. 16-39, 1981). Guam rails were classified a game species between 1964-1976 (Guam Dept. Agr. Hunting Regulation 10, 1964). However, the majority of the forest birds were legally protected on Guam by the turn of the century (Executive Order No. 61, Naval Governor of Guam, 1903),

and forest birds have declined on military land where hunting of native species was prohibited (Savidge 1984). Although hunting may have produced additional stress on certain populations such as the kingfisher, crow, starling, and rail, there is no evidence to suggest it was responsible for the recent declines.

Avian Disease -- Several exotic birds that could serve as disease reservoirs or carriers have been introduced to the Mariana Islands since the 1950's. The number of mosquito species on Guam has also greatly increased in the past few decades due to accidental introductions through increased air traffic (Nowell 1975).

To identify the occurrence and prevalence of infectious disease on Guam, Savidge and Sileo (1985, unpubl. data) sampled a variety of domestic, native, and introduced birds on Guam for bacteria, viruses, and parasites between 1982 and 1985. In general, native forest birds were free of disease (Savidge 1986b). No blood parasites were detected.

A sentinel study exposing four species of birds to potential disease vectors was conducted in August and September 1984 to detect any pathogenic diseases in the habitat of remaining forest birds (Savidge 1986b). Chickens, coturnix quail, and canaries were shipped from the mainland and bridled white-eyes (a non-listed subspecies common in the Northern Mariana Islands) were mist-netted on Saipan and sent to Guam. Chickens at one site developed lesions consistent with pox virus infection, but the virus appeared to be a host-specific strain as none of the other sentinels, including the bridled white-eyes, was affected. Samples obtained during the experiment are still being analyzed, but those analyzed thus far revealed no disease capable of causing the decline of native forest birds. Savidge, and Sileo (1985, unpubl. data) concluded that to date there was no evidence suggesting infectious diseases were extirpating the forest birds on Guam. The pattern of the avifaunal decline on Guam (gradual

shrinking range over time) also does not match a decline expected as a result of an avian disease epidemic.

Avian diseases have not been investigated in the northern Mariana Islands, including Rota. Census data indicate bridled white-eyes are scarce at low elevations on Rota, and that the Vanikoro swiftlet has recently disappeared from the island. There is concern that disease may be responsible (Engbring et al. 1986), and research is needed on avian diseases.

Predation -- Several species of predators have been introduced to the Mariana Islands including feral dogs, cats, three species of rats (Rattus exulans, R. rattus, and R. norvegicus), a monitor lizard (Varanus indicus), and the brown tree snake (Boiga irregularis).

The only predator occurring on Guam and not on the other islands is the brown tree snake. This nocturnal, arboreal predator occurs naturally in parts of Australia, New Guinea, Solomon Islands, and the Indo-Malayan archipelago. Research by Savidge (1986a, b) indicates the brown tree snake is responsible for the range reductions and extinctions of the forest birds on Guam within the last several decades. Savidge found birds and bird eggs made up 32.2 percent of the brown tree snake's diet on Guam. Domestic birds and their eggs dominated the sample, but forest bird populations were near extinction at the time of her study. Limited examination of snake stomachs collected prior to 1982 revealed a Micronesian starling, cardinal honeyeater, and Guam rail (GDAWR 1985, unpubl. data).

Savidge (1986a, b), found a strong correlation between the range expansion of the brown tree snake on Guam and the range contraction of the forest avifauna. The brown tree snake was first sighted in the Santa Rita area of southern Guam in the early 1950's. By the early 1970's, it was found throughout southern

Guam while the birds were largely restricted to the northern half of the island. The brown tree snake then apparently expanded its range to the north. Ritidian Basin, at the northwest tip of Guam and the last area to harbor all species of forest birds, was the last area infiltrated. Through the use of bird-baited funnel traps, Savidge (1986a, b) found snake predation to be exceptionally high in areas where birds had been decimated as opposed to low or non-existent in areas with stable bird populations. In a 1984-85 study of the introduced Philippine turtle-dove, Conry (1986) found low nest success in both forest (0.7%) and man-made habitat (21.2%). Predation by the brown tree snake accounted for 92.7% of all egg and nestling mortality.

The black francolin (Francolinus francolinus) and the yellow bittern (Ixobrychus sinensis), inhabitants of open savannas or freshwater wetlands, have not suffered these remarkable population declines. These habitats are largely unoccupied by the brown tree snake.

E. Conservation Measures Already Taken

Legal Protection and Law Enforcement -- The majority of forest birds were protected on Guam by the turn of the century (Executive Order No. 61, Naval Governor of Guam, 1903). In 1960 the enactment of Guam Public Law 6-87 prohibited the taking, buying or selling of wild birds or their eggs. In addition, it authorized the Guam Department of Agriculture, through its Division of Aquatic and Wildlife Resources (then known as the Guam Division of Fish and Wildlife), to set hunting seasons and bag limits on game birds, which at that time included the Guam rail. The first controlled season for Guam rails occurred in Sept-Oct of 1964 and continued on a yearly basis until 1976 when the hunting season for the Guam rail was closed (Anon. 1966, Anon. 1976). Public Law 16-39, passed September 11, 1981, removed crows and kingfishers

from the list of unprotected birds, providing them their first legal protection.

The Endangered Species Act of Guam (Guam Public Law 15-36), which protects both locally listed and federally listed endangered species on Guam, was enacted on June 18, 1979.

The Guam rail was placed on the U.S. Federal Endangered Species List on April 11, 1984 by an emergency rule (49 FR 14354-14356). On August 27, 1984, the Guam rail, Mariana crow, Guam Micronesian kingfisher, Guam broadbill, and Guam subspecies of the bridled white-eye were given endangered status under the U.S. Endangered Species Act of 1973, as amended (49 FR 33881-33885). Critical habitat was not designated under this listing rule.

Conservation laws on Guam are enforced by Conservation Officers of the Guam Division of Aquatic and Wildlife Resources (GDAWR) of the Government of Guam and to a lesser extent by security forces on military bases and a single Federal (National Marine Fisheries Service) law enforcement agent. From the mid-1960's to the late 1970's, the GDAWR employed three to five Conservation Officers.

This number increased to eight officers in 1981 when additional funding became available through the Coastal Zone Management program of the U.S. Department of Commerce and the Government of Guam.

Protected Areas -- The Government of Guam has established four conservation reserves that occupy 1,700 ha of land for the protection of habitat. Two reserves, Anao and Y-Pigua, are located in northern Guam, while two others, Cotal and Bolanos, occur in the southern half of the island. In 1973, the Air Force set aside a 281-ha area of cliffline habitat, designated as the Pati Point Natural Area, on AAFB for nature conservation. In 1985, the U.S. Navy established an ecological reserve at Haputo

that contains about 72 ha of native forest.

Cocos Island, located 2.5 km offshore of southern Guam, is 39 ha in size with 12 ha included in Guam's Territorial Seashore Park by Executive Order of the Governor of Guam. Cocos Island still harbors all its historically known bird species including the reef heron (Egretta sacra), yellow bittern (Ixobrychus sinensis), white tern (Gygis alba), and the Micronesian starling. Unfortunately, due to its small size, the significant tourist development in the private areas, and the vulnerability of the island to typhoons, it is probably not suitable as a wildlife reserve for endangered species.

Captive Breeding -- In November 1982 the GDAWR decided to develop a captive breeding program for Guam's endemic endangered native bird species and subspecies focusing on the Guam rail, bridled white-eye, and Guam broadbill (Beck 1983). A cooperative program for the captive breeding of Guam's endangered species was initiated between the GDAWR and several mainland zoos (Philadelphia Zoo, Philadelphia Zoological Society; Bronx Zoo, New York Zoological Society; National Zoological Park, Smithsonian Institution) in association with the American Association of Zoological Parks and Aquariums (AAZPA). Unfortunately, by fall 1983, efforts to capture the bridled white-eye and Guam broadbill were abandoned as none could be found in the wild (Beck 1984b).

Attention then turned to the Micronesian kingfisher. Six pairs were sent and divided up among the Philadelphia and Bronx Zoos in January 1984. In December 1984, nine kingfishers and in January 1986, eight kingfishers, were transported to mainland zoos. Presently, Guam Micronesian kingfishers are being captive bred at the Bronx Zoo, National Zoo, Philadelphia Zoological Gardens, San Antonio Zoo, and St. Louis Zoo. The first captive-bred kingfisher was hatched at the Bronx Zoo in May 1985 (Shepard 1985, pers. comm.). As of December 1986 there were 36 kingfishers in

captivity at mainland zoos.

The Guam rail, which is being bred both on Guam and at mainland zoos, was first brought into captivity at GDAWR facilities in March 1983 (Beck 1983). In March 1984, 4 rails were transported to the Conservation and Research Center (CRC), National Zoological Park, Front Royal, Va. In December 1984, 12 more rails were transported to the mainland and divided between the Bronx Zoo and CRC (Beck 1985a). The first captive-bred rails were hatched at the GDAWR in April 1984 (Beck 1984b). In January 1986, an additional 13 rails were transferred from Guam to the CRC and 5 captive-bred rails were returned from the CRC and the Bronx Zoo to Guam (Beck 1986a). As of December 1985 there were 61 rails in captivity on Guam, CRC, Bronx Zoo, San Diego Zoo, Pittsburg Aviary, and the Cincinnati Zoo (Beck). The prognosis for successful captive breeding of this species appears to be good (Derrickson 1986).

By May 1985 the Guam rail population in the wild was at such a low level (the GDAWR was unable to locate more than one or two individual rails) that efforts at capture of additional founders was suspended (Beck 1985).

Research -- The GDAWR has conducted research on basic ecological requirements of all Guam birds, on the impacts of brown tree snakes on the avifauna, and on other factors relating to the status and distribution of the native forest birds. Research on the brown tree snake has been significantly aided by herpetological experts.

Public Education -- A conservation education program was initiated on Guam through a grant from Coastal Zone Management in December 1979. GDAWR continued the program until June 1984 when funds ran out. The focus of the program was to educate the public about Guam's wildlife resources and the need to protect endangered

species. Major accomplishments included:

1. A slide/tape program for elementary age children was produced and presented at local public and private schools.

2. Four thousand sets of flyers (40 flyers to a set) illustrating and discussing Guam wildlife were produced and distributed primarily to schools.

3. The GDAWR distributed 500 "Poaching" posters to the public.

4. Four posters depicting a) "Habitats of Guam"; b) "Reef Fish"; c) "Endangered Species"; and d) "Living in Harmony with Nature" were designed and distributed to the public. Four thousand copies of each poster were printed.

5. Coloring book/activity guides for elementary age children were distributed to public and private school teachers.

6. Press releases concerning GDAWR projects were prepared.

7. Television and radio public service announcements were produced on endangered species.

8. Workshops were organized for the Guam Police Academy and Criminal Justice programs to acquaint prospective enforcement officers with fish and game laws.

In the CNMI, the staff of the CNMI Division of Fish and Wildlife wrote columns in a local newspaper, the Marianas Variety, concerning endangered species and other wildlife resource concerns.

II. RECOVERY

A. Objective

The primary objective is to prevent the extinction of listed species. Major tasks that must be completed include capturing remaining wild birds, initiating captive breeding projects, and planning for future releases to reestablish listed species when there has been effective control of the brown tree snake. For the crow and kingfisher, an adequate amount and quality of essential forest habitat needs to be secured to maintain recovered populations. Interim recovery objectives are:

- Guam rail: establish captive populations for transplant and reestablishment projects. Establish a wild population of at least 2,000 birds, 1,000 on northern and 1,000 on southern Guam.

- Guam Micronesian kingfisher: establish a wild population of at least 1,500 birds, 1,000 on northern and 500 on southern Guam.

- Mariana crow: maintain at least 700 crows on Rota and restore the Guam population to at least 700, with at least 500 on northern and 200 on southern Guam.

- Bridled white-eye and Guam broadbill: find and capture any surviving individuals, then ascertain whether captive breeding and transplanting is possible.

The population levels given are interim recovery objectives and should be re-evaluated when they are reached and maintained for at least 5 consecutive years, or when further research allows for a better definition of recovery goals.

A major objective for all the species is to develop methods for control of predation by the brown tree snake, which would then allow reintroduction of captive birds into their historically

known range. Downlisting to threatened status should be considered when predation by the brown tree snake is controlled and populations of each species reach the population levels given.

B. Narrative

1. Develop cooperative agreements for management, research and protection of endangered species on both Guam and Rota.

Agreements between the U.S. Fish and Wildlife Service, the Commonwealth of the Northern Mariana Islands, and the Territory of Guam should be developed. Such agreements will formally define the individual responsibilities of the various government entities for the research, management, and protection of endangered species.

2. Conduct annual status surveys.

Continuation of present survey efforts will allow accurate monitoring of the population status of each species. Efforts should be made toward annual surveys.

21. Conduct status surveys on Guam.

The GDAWR as the resident wildlife agency, shall conduct the annual status surveys on Guam.

22. Conduct status surveys on Rota.

The CNMIFWD as the resident wildlife agency, shall conduct annual status surveys for the Mariana crow on Rota.

3. Continue the development of a captive breeding program.

Due to the rapid nature of the decline of these five species, a captive breeding program for the species still extant in the wild is the only means presently known to prevent their extinction. Successful programs are underway to breed Guam rails and Guam Micronesian kingfishers at several mainland zoos. Captive breeding is also planned for the Mariana crow. If the Guam broadbill and the bridled white-eye are ever found in sufficient numbers, these species should be included in such a program.

31. Study breeding biology of the Guam rail, Micronesian kingfisher and Mariana crow.

A successful program of captive breeding will require knowledge of the breeding biology of each species in the wild in order to provide optimal captive breeding conditions.

311. Study breeding biology on Guam.

A continuation of breeding biology studies of the Guam rail, Guam Micronesian kingfisher and Mariana crow on Guam should be done by the GDAWR.

312. Study breeding biology of Mariana crow on Rota.

A study of the breeding biology of the Mariana crow should be initiated to provide data needed for a captive breeding effort. Because this species is still relatively common on Rota, work should be done there.

32. Continue development of a captive breeding program for the Guam rail and the Guam Micronesian kingfisher.

Development of a total captive population of 200-250 individuals of each species divided among several facilities would insure maintenance of genetic variation and provide protection against catastrophic accidents at any one facility. Incorporate safeguards to prevent disease epidemics under confinement conditions.

321. Continue capturing kingfishers and rails.

A founder population of 30-50 individuals for each species from throughout its remaining range will insure that an adequate sample of the genetic variation still left in the wild is a part of the captive-bred population. Efforts should be made to add more wild birds to the captive flocks, if any still exist.

322. Continue captive breeding program for the Guam rail.

Captive breeding should be conducted at several locations to take advantage of the avicultural expertise of various facilities and to guard against catastrophic loss at any one facility. Develop safeguards to prevent disease outbreaks under confinement conditions.

3221. Develop and maintain a rail breeding colony on Guam to hold 100 rails.

Continue the development of the present GDAWR rail breeding facility to hold at least 100 rails.

3222. Develop and maintain stateside zoo facilities for up to 150 rails.

Additional facilities off-island for up to 150 rails will bring the population up to the 250 estimated necessary to maintain adequate genetic variation.

323. Continue captive breeding program for the Micronesian kingfisher.

Adequate expertise and facilities for holding and breeding Micronesian kingfishers are available only in stateside zoos at the present time. Facilities are needed at cooperating zoos to breed and hold up to 250 birds. Develop safeguards to prevent disease outbreaks under confinement conditions.

33. Provide Mariana crows for reintroduction to Guam.

The Mariana crows needed for a reintroduction program to Guam could come from a captive breeding program (parent stock from Guam or Rota) or directly from Rota. These alternatives should be evaluated and given top priority.

331. Study the feasibility of capturing crows on Rota and transplanting to Guam; implement if deemed reasonable.

Capturing crows on Rota for transplant to Guam would be much simpler than a captive breeding program. The feasibility of this should be studied, including the taxonomic relationship of the crow on the two islands, the impact this may have on the Rota population, the adaptability of the bird to a transplant operation, etc. If this alternative proves feasible, this should be pursued.

332. Develop captive breeding techniques for and determine the feasibility of captive breeding the Mariana crow.

Captive breeding techniques should be developed for the Mariana crow so that the feasibility, if any, of augmenting populations on Guam from captive stocks can be ascertained.

3321. Capture 2-4 pairs of Mariana crows on Guam.

An initial captive flock of 2-4 pairs will be used to develop captive breeding techniques.

These birds need to be captured before this species declines to levels that may prevent initiation of this task.

3322. Attempt first breeding of the Mariana crow.

A cooperative breeding effort is already underway for several endangered Guam Birds at U.S. zoos. They will also begin development of captive breeding techniques for the crow. Develop safeguards to prevent disease outbreaks under confinement conditions.

34. Develop captive breeding programs for the Guam broadbill and bridled white-eye if feasible.

If populations of the Guam broadbill or bridled white-eye are located (see Task 21), captive breeding program should be started at once in cooperation with the AAZPA.

341. Determine if any birds remain on Guam, bring into breeding program, if possible.

These two taxa are currently thought to be extinct, however, efforts (both direct and incidental) should continue to determine if there may be birds still remaining. If birds are found, the potential for capture and incorporation into a captive breeding program should be assessed and implemented.

342. Gather breeding biology information using surrogate species.

Even if additional individuals of these two species are found in the wild, there will never apparently be enough wild birds to learn the breeding biology parameters needed in a captive breeding program. If this information becomes required, adequate information may be obtained from closely related species in Micronesia.

343. Develop zoo breeding facility for broadbills and white-eyes if appropriate.

Adequate expertise and facilities for holding and breeding broadbills and white-eyes are available only in stateside zoos at the present time. A cooperative breeding effort is already under way for several endangered Guam birds at U.S. zoos. Facilities are needed at these cooperating zoos to breed and hold up to 250 broadbills and 250 white-eyes if founder stock

is found in the wild on Guam.

344. Capture broadbills and white-eyes if appropriate.

Since a founder population of 30 to 50 individuals for each species from throughout its remaining range is not possible, all wild birds for each species found should be captured and used as a founder population if any exist. Efforts should be made to add more wild birds to the captive flock, if an initial capture is done.

4. Reduce avian mortality in the field.

Avian mortality must be reduced to maintain existing bird populations and to allow captive-bred birds to be reintroduced to Guam.

41. Avian disease.

Avian disease has been implicated as a possible threat to bird populations on Guam and Rota. Research to date provides no evidence that diseases are responsible for the decline of forest birds on Guam. However, ongoing investigations need to be completed. The prevalence of bird disease on Rota should be investigated. It is important that pathogens are not introduced to either Guam or Rota in the future.

411. Complete present research into the cause of the avian decline on Guam.

All phases of ongoing disease research should be completed to provide a thorough determination of the role of disease in the avian decline.

412. Investigate the prevalence of disease in the Northern Mariana Islands.

A wide variety of birds should be surveyed for disease on Rota and (as a control) on Saipan, where forest bird populations appear stable. Additionally, a sentinel study involving native birds, particularly white-eyes, should be conducted on Rota. If diseases are found, native birds should be inoculated with the disease to determine disease pathogenicity.

413. Continue to monitor for disease.

Endangered birds found injured, mist-netted, or captured for captive propagation should be sampled for

disease, and all carcasses of endangered species obtained should be subject to intensive post-mortem examination.

414. Take steps to prevent the introduction of avian disease and disease vectors to Guam and the CNMI.

The introduction of pathogenic avian diseases could severely hamper future avian reintroductions and could further endanger populations of the Mariana crow on Rota.

4141. Restrict importation of exotic bird species to Guam and Rota.

All birds imported from other parts of the world are possible carriers of disease and potential competitors with native species. The possible establishment of wild populations would be decreased if the number and variety of birds imported was more strictly regulated. A list of acceptable species, demonstrated to pose no threat needs to be developed and all other species should be prohibited entry. The CNMI has already prepared such a list for their islands.

4142. Implement stricter screening requirements for importation of birds.

Currently, imported birds are not quarantined and health certificates for exotic birds require few ancillary tests. Stricter requirements are needed to reduce the potential for introducing new diseases.

4143. Prohibit the release of exotic birds on to Guam and Rota.

The release of any exotic birds should be a misdemeanor subject to a fine. The GDAWR and CNMIFWD need to be empowered with the authority to prevent such activity.

4144. Implement stricter screening of incoming aircraft and ships for potential disease vectors.

Up to 39 species of mosquitoes have been introduced to Guam (Nowell 1975). Reliable quarantine procedures need to be developed,

implemented, and enforced to prevent future introductions. Cargo destined for Guam or Rota should be carefully inspected and/or sprayed by appropriate authorities prior to leaving their ports of origin and carefully examined on arrival by qualified quarantine officers.

42. Monitor levels of pesticide use and enforce pesticide usage laws.

Guam Environmental Protection Agency (GEPA) has been delegated authority by the EPA to implement and enforce both federal and local pesticide rules and regulations on Guam. The mandates include activities that regulate the importation, distribution, sale, use, storage and disposal of pesticides on Guam. GEPA should continue their pesticide enforcement program.

43. Predators.

Research indicates predation by the brown tree snake is responsible for the decline of Guam's forest avifauna. Other predators may also be affecting the birds to some degree. It is essential that predator numbers (primarily brown tree snake but other predators if found necessary) be reduced to levels that will allow recovery of the native birds.

431. Determine impact of predation by mammals on endangered forest birds and implement control measures, if necessary.

Feral dogs, cats, and three species of rats are abundant on Guam. Whereas dogs are restricted largely to urban areas, populations of feral cats have greatly increased within the past several years within the habitat of remaining forest birds in northern Guam (Savidge). Until recently rats were ubiquitous on Guam and black rats are arboreal and known to prey on bird's eggs in other localities. The effect of predation by these animals on native forest birds on both Guam and Rota needs to be continually assessed and control actions taken as necessary.

432. Eliminate/control snakes.

Data indicates predation by the brown tree snake is responsible for the recent precipitous decline of the forest avifauna on Guam. Ideally, efforts need to be aimed at eliminating this predator from Guam. Though it may be impossible to eradicate this snake, research efforts may reveal methods to reduce its numbers on

Guam and prevent its introduction to Rota and other Pacific Islands.

4321. Conduct research on the biology and ecology of brown tree snake to determine limiting factors.

Further research on the biology and ecology of the brown tree snake is necessary to fully understand the impact of this species on its vertebrate prey, for the development of a control program, and to have pre-control data available to compare with data gathered after snake control programs have been enacted to determine their effectiveness.

43211. Study the home range, diurnal retreats, and activity patterns.

Home range, diurnal retreats, habitat preferences, and activity patterns are being determined by use of radio-telemetry (Wiles, unpubl. data). Home range determination will aid in population estimation. Several snake aggregation sites have been found on Guam (Savidge, unpubl. data), and the purpose of these sites should be identified as they could be valuable in control efforts.

43212. Continue study of breeding biology on Guam.

Data have been gathered on age of reproductive maturity, clutch size, and breeding season (Savidge, unpubl. data). Studies should be continued to augment sample size.

43213. Determine the origin of the Guam population of brown tree snake and initiate research on its biology (particularly causes of mortality and limiting factors) in its native range.

Determining natural causes of mortality and factors limiting population growth within the brown tree snake's native range may suggest possible ways of biologically controlling brown tree snakes on Guam.

43214. Continue research on feeding habits, snake population age structure, and densities on Guam.

Snakes have been collected on a regular basis and head and body measurements taken, and stomach and intestinal tracts examined for remains of prey items (Savidge 1986a). These analyses should continue in order to document what prey the various size classes are taking, and to gain information on the age structure of the snake population. Relative density estimates have been obtained for forest and savanna habitats. Abundance estimates for other habitats would aid in planning degree of effort needed for control and serve to assess success or failure of control methods once initiated.

4322. Develop control methods for brown tree snakes.

A variety of control methods should be investigated and consideration given to methods applicable to large and small areas, recently introduced snake populations, and individual nest sites of birds.

43221. Investigate snake attractants (including pheromones) and develop potential traps.

Live-baited traps have proved to be an effective way for gathering biological data on brown tree snakes, but these require considerable maintenance (Savidge, unpubl. data), Research may reveal acceptable artificial baits or effective passive traps. The snake aggregation sites suggest individuals may locate each other by means of pheromones, and research on these chemical attractants should be conducted.

43222. Test possible repellents and barriers to snake movement.

Adhesive resins or other repellents may prove successful in protecting individual nest trees. Snake-proof fences may be useful in preventing snake immigration

into cargo storage areas or shipping facilities.

43223. Investigate possible chemical and biological methods of control.

Due to unintended effects such as direct toxicity to non-target organisms or food-chain concentration, the massive use of any chemical as a poison is unlikely to be recommended. If an effective chemical were found, this could be used in specific situations such as spraying cargo holds in ships or airplanes or mixing it with bait that, once ingested, would poison snakes. A biological agent could possibly control snake populations island-wide and would be the only potential form of self-sustaining control. Research is necessary to investigate natural limiting factors that could control the snake population on Guam. If any biological agents are discovered that are effective in controlling the brown tree snake in its native habitat, use of these agents on Guam must be carefully evaluated prior to implementation to ensure specificity.

43224. Investigate the potential of a snake hide industry and/or bounty and encourage take of snake for food.

Human use of the brown tree snake may help reduce snake populations in accessible areas. Such uses should be encouraged.

4323. Implement snake control methods on Guam.

Implementation of control methods will require close cooperation between the Government of Guam, the Commonwealth Government, the U.S. military and the U.S. Fish and Wildlife Service. Control programs should be monitored to document successes and failures and to provide a basis for modification of techniques to allow increased efficiency, economy, and expansion to larger areas.

43231. Reduce snake populations or eradicate snakes in areas of remaining native bird species.

Control techniques should be initially concentrated in target areas having native forest birds. The immediate goal would be to reduce predation to at least tolerable levels. Both snake densities within the area and immigration into the area should be controlled.

43232. Snake-proof nesting trees of Mariana crows and other appropriate species.

If an adequate number of nest sites and adjacent trees used for roosting or perching were protected, some species may be able to maintain population numbers.

43233. Reduce or eradicate snakes on Guam prior to reintroduction of captive-bred birds.

To the extent that methodology will allow, efforts should strive for control and/or eradication of snakes over as large an area as possible. Reintroduction of forest birds should not be attempted until predation pressure from snakes is significantly reduced.

4324. Prevent snakes from colonizing the CNMI and other Pacific Islands.

Methods must be devised to prevent the introduction of brown tree snake on Rota. The likelihood of snakes being transported from Guam (or elsewhere) must be reduced and methods developed to monitor for and capture any individuals that are introduced. Concurrent and concerted efforts from the governments of both the CNMI and Guam will be needed.

43241. Inform public, military, and officials on hazards of snake introduction.

Information materials should be provided to the public and military personnel, particularly those involved in transport

of goods/ equipment between Guam, the CNMI, and other Pacific Islands. An educational film on the hazards of snake introduction could be developed and shown on television and in schools. This would help generate public awareness regarding the hazards of snake introductions.

43242. Implement stricter screening of cargo exported from Guam and imported into the CNMI.

Information materials and training in the detection of snakes should be provided to private and military personnel in cargo dispatch areas on Guam, the CNMI, and other Pacific Island, and personnel inspecting importations in this area.

43243. Control with a goal to eliminate snake populations in cargo dispatch areas.

Methods should be developed specifically for detecting and capturing snakes in cargo dispatch areas and other transportation facilities.

43244. Develop methods to monitor for recent introductions of snakes and prevent population spread should snakes be introduced to the CNMI and other Pacific Islands.

Target areas, such as locations near cargo receiving facilities, should be monitored for snake presence on Rota and traps and/or barriers employed to restrict the spread of snakes.

433. Prevent importation and establishment of additional avian predators on Guam and Rota.

The importation of additional potential avian predators (for example, the mongoose) should be prevented. Should new predators be encountered, efforts should be made to immediately eliminate the introduced individuals.

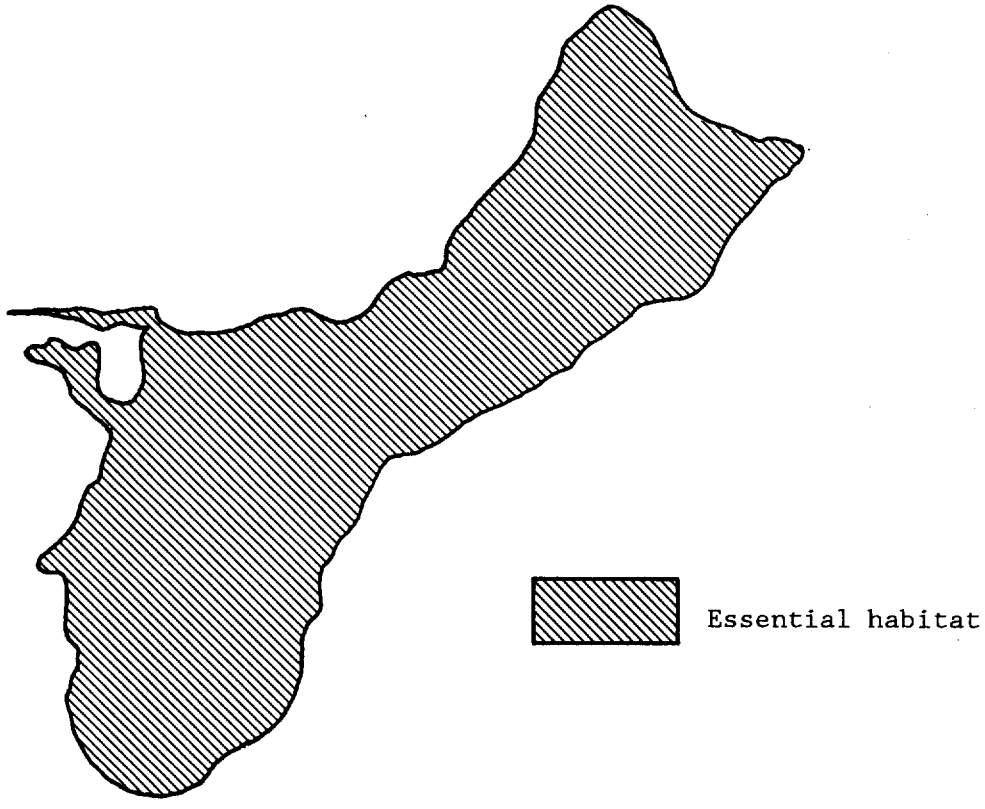

Figure 7. Essential habitat for the Guam rail, Guam Micronesian kingfisher, Mariana crow, Guam broadbill, and bridled white-eye.

*Essential habitat excludes highly urbanized areas, roads, physical structures not required by the listed species for their continued survival.

5. Provide maximum legal protection for essential habitats for preserving and/or enhancing recovery of endangered forest birds.

Some form of legal protection for all essential native forest bird habitat is a necessary prerequisite for developing long term management programs for promoting recovery of these species (Figure 7).

51. Secure (through cooperative agreement, lease, easement, executive order, etc.), preserve, and manage high priority essential habitats in northern Guam.

The continuous band of coastal habitat around the northern end of the island extending from Dos Amantes Point on the west coast of Guam, north around Ritidian and Pati Points, and south to Campanaya Point on the east coast was the last remaining habitat for many of the native forest birds during the last stages of their decline. The significant tracts of native limestone forests in this area appear to represent preferred habitat and must be protected and managed.

511. U.S. Government property.

Most essential habitat is on U.S. Government, primarily military, land. Much of this land is pristine native forest and is in areas not being actively used by the U.S. Government and/or present use levels are not known to be in conflict with endangered species usage.

5111. U.S. Naval Facility.

All forest on Naval Facility property at Ritidian (Figure 8, Unit 3) should be protected. Present use levels of this land should be allowed to continue.

5112. Andersen Air Force Base.

The last remaining population of the Guam rail, Micronesian kingfisher and Mariana crow on Guam are on AAFB in native and second-growth forest. This habitat needs to be protected from further development although present use levels are apparently tolerated.

51121. Coastal Forest.

The area included would extend from the beaches to the cliffline and

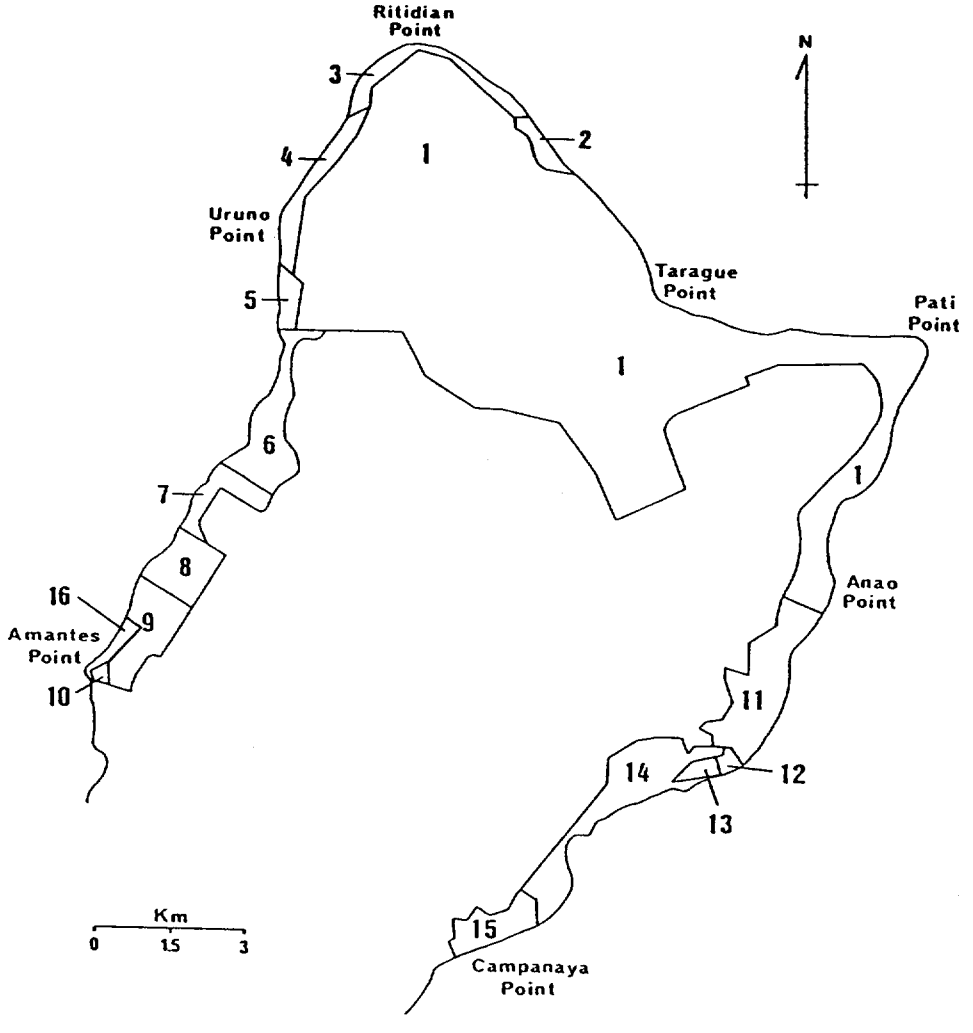

Figure 8. Essential habitat of Guam forest birds in northern Guam. Key to designated areas: Andersen Air Force Base (1); Jinapsan Basin Area (2); Naval Facility (3); Uruno Basin Area (4); territorial property at Falcona Beach (5); Naval Communications Area Master Station (6); Federal property at Ague Point (7); Navy (8); Air Force (Harmon Annex) (9); Puntan Dos Amantes Park (10); Anao Conservation Reserve (11); private property at Janum Point (12); Lot Numbers 7102 and 7103 (13); Lot Number 7147 (14); Lot Number A (15); and private property at Dos Amantes Point (16).

approximately 1.0 km interior from the cliffline (Figure 8, Unit 1). Much of the area is mature forest and is not being used by the Air Force.

51122. Conventional Weapons Storage Area.

Much mature native forest and second-growth forest remain in this area between the weapons storage revetments. Present use levels are apparently tolerated as this area was the center of distribution of the last remaining, wild native forest birds on Guam.

51123. Northwest Field.

Much good native and second-growth forest remain in the Northwest Field area. Presently both the Mariana crow and Micronesian kingfisher are found in this area.

51124. Harmon Annex.

Coastal forest between the beach and cliffline (Figure 8, Unit 9) and extending approximately 1 km east (interior). This area is primarily native forest, relatively unused and inaccessible, and administered by the Air Force.

5113. Federal Aviation Administration Housing, Ague Point.

Coastal forest extending from the cliffline to the beach and up to 1 km east of the cliffline on Federal Aviation Administration property at Ague Point (Figure 8, Unit 7) should be protected. Much of this land is native forest and is not presently being used by the FAA. Present usage levels of adjacent areas would not be affected.

5114. U.S. Naval Communication Area Master Station.

Coastal native forest between the cliffline and the beach and from the cliffline up to 1 km to the east on U.S. Naval Communication Area Master Station (NAVCAMS), Finegayan should be protected. Included are NAVCAMS, Finegayan

(Figure 8, Unit 6); Naval Housing Area, South Finegayan (Figure 8, Unit 8); and the Tanguisson Beach Area, NAVCAMS (Figure 8, Unit 8).

512. Territory of Guam land.

Most of the Government of Guam's land included in essential habitat is on the northeast coast of the island and is presently zoned "A" (agriculture) and designated for conservation use in the Guam Public Land Use Plan.

5121. Anao Conservation Area.

This area extends from the AAFB southern boundary, south along the east coast to Janum Basin (Figure 8, unit 11). This area contains much pristine native forest and has already been designated as a Conservation Reserve by law.

5122. Pagat and Luminao Basin.

Coastal lots #7102, 7103, A (Portion) and 7147 south of the Anao conservation area extending to Companaya Pt. along the east coast should be secured (Figure 8, Units 13, 14, and 15). This land is zoned agriculture and has a Guam Land Use Plan Designation of conservation.

5123. Puntan Dos Amantes Park.

Use of this area at present levels for recreational purposes only would be permitted in order to protect essential habitat (Figure 8, Unit 10).

5124. Falcona Beach Area.

This area (Figure 8, Unit 5) is zoned agriculture with Guam Public Land Use Plan designation of conservation.

513. Privately owned lands.

Parcels of privately owned lands within the area designated as essential habitat for recovery of endangered forest birds need to be protected from uses incompatible with recovery of these species.

5131. Uruno Basin Area.

Secure and protect in perpetuity essential

forest habitat on private property in the Uruno basin from Achae Point to Falcona Beach (Figure 8, Unit 4). The area to be protected is from the cliffline to the beach. Present usage levels and patterns would be maintained.

5132. Jinapsan Basin area.

Secure and protect in perpetuity essential forest habitat on private property in the Mergagan Pt. (Figure 8, Unit 2). The area to be protected extends from the cliffline to the beach. Present usage patterns and levels would be maintained.

5133. Janum Basin area.

Secure and protect in perpetuity essential forest habitat on private property in the Janum point area (Figure 8, Unit 12). The area to be protected extends from the cliffline to the beach. Present usage patterns and levels would be maintained.

5134. Dos Amantes Point area.

Secure and protect in perpetuity essential forest habitat on private property north of Amantes Point (Figure 8, Unit 16). The area to be protected extends from the cliffline to the beach. Part of this land is currently threatened by a proposed development project.

52. Protect and manage essential habitats for endangered forest birds comprising important historical range in southern Guam.

Identify high quality historical habitats of endangered forest birds in southern Guam through evaluation of old GDAWR reports/documents and other literature. Secure these areas necessary for promoting recovery of these endangered forest birds.

521. Evaluate government and Private lands in southern Guam which represent essential habitat for listed species.

Historical distribution of all of the listed species will be evaluated to determine those habitats and/or areas which supported high densities of endangered species in the past.

522. Determine priority ratings for these essential habitats.

These essential habitats will be ranked in priority based on historical use by the highest number of listed species, degree of present threat to those lands, and difficulty in securing maximum legal protection.

523. Secure management control of these essential habitats (through cooperative agreement, lease, easement, purchase, etc.).

Provide secure protection for these essential habitats in southern Guam through all means, including purchase in fee, and manage to promote recovery.

6. Conduct additional research necessary for refinement of recovery tasks and goals.

Active management to maintain and improve the existing quality of essential habitat or prevent damage by exotic organisms may be necessary in certain areas. This information will need to be gathered to develop the management strategies.

61. Develop techniques for rehabilitating essential second-growth habitat to native forest status.

Should research indicate that additional high quality native forest is needed, appropriate second-growth habitat that has already been declared essential may be upgraded to native forest status by application of appropriate forestry management techniques.

62. Conduct research into the need for and methods to accomplish control of exotics in the essential forest habitat.

Guam has many exotic organisms in the native forest and their effects on the forest should be determined and if necessary steps should be undertaken to control the problem species.

621. Determine the effects of the sambar deer (Cervus unicolor) on essential forest habitat and develop control methods, if needed.

The sambar deer was introduced to Guam in the late 1700's. Densities of deer on Andersen Air Force Base are extremely high, and their effects on the forest's regeneration should be determined and controlled if

necessary.

622. Determine the effects of feral goats and pigs on the essential forest habitat and develop control methods, if needed.

Pigs and goats have been feral on Guam since the Spanish era and pigs are presently very abundant in the CWSA, Northwest Field and Pati Point areas.

623. Determine the effects of insects in essential forest habitat and control, if necessary.

Introduced insects are a major economic problem on agricultural plants on Guam. Now that the native insectivorous birds are basically extinct on Guam, Native insects may also reach epidemic numbers. The impact of all insects on the native forest should be investigated and control techniques implemented if necessary.

624. Determine effects of exotic plants in essential forest habitat and control, if necessary.

Effects of exotic plants on the quality of essential habitat should be determined and controlled if necessary.

63. Continue research on habitat requirements for endangered native birds found on Guam and Rota.

To properly determine the quality and quantity of habitat necessary to maintain a self-sustaining population of each forest bird species, research into habitat requirements for each species still left in the wild should continue.

64. Determine essential habitat for the Mariana crow on Rota.

The CNMIFWD should determine what areas in Rota are essential to the crow (i.e. habitats required to maintain existing population) based on ongoing research in tasks 22 and 63.

65. Determine population demography criteria so reclassification/delisting criteria objectives can be set.

Research needs to be done on the population dynamics of listed species which will include determination of minimal population sizes needed for long term genetic stability and survival. Upon completion of this research interim recovery

goals can be reassessed and reclassification and delisting objectives can be set.

7. Develop methods for introduction of endangered birds and implement when appropriate.

Several of Guam's endangered birds are being bred in captivity to prevent their extinction. When the causes of their decline in the wild are controlled, methods will be needed to facilitate their introduction back into essential forest habitat.

71. Study the feasibility of introducing the Guam rail to Cocos Island, Rota, or other islands and implement when appropriate.

It will probably be many years before the brown tree snake, the apparent principal cause of the decline on Guam, is controlled. Islands such as Cocos Island or Rota, which has no known rails or ecological equivalents and have habitat very similar to Guam's, would appear to be an excellent location to establish a wild population of rails. If such a population becomes established it would serve as a source of birds for reintroduction to Guam at some later date. The legal status of such a population (outside the historical range) would have to be clarified first and necessary permits and approvals obtained. It must also be demonstrated that the rail will not have a negative impact on the Rota ecosystem.

711. Determine if Rota (or other sites outside the native range of this species) is a suitable environment for the rail.

The suitability of Rota (or any other island outside the native range of this species) as a release site must be assessed. This assessment must include the anticipated ecological impacts of the rail on the environment and the impact the "foreign" environment may have on the evolution of the rail. Permission from authorities must also be obtained.

712. Determine optimum sites for releasing rails on Rota.

Upon satisfying task #711, proper habitat conditions must be identified on Rota (or other site chosen).

713. Develop methods for releasing rails on Rota.

Methods of release, specific for this species, are needed to ensure maximum survival and adaptation to the wild environment.

714. Release rails on Rota.

Upon satisfying Tasks 711, 712, and 713, when Guam rails are available, they should be released according to prescribed methods developed in Task 713.

72. Study the feasibility of re-establishment of the Guam rail and Guam subspecies of the Micronesian kingfisher from captive populations to essential forest habitat on Guam and implement when appropriate.

When the snake has been successfully controlled on Guam, these endangered birds should be reintroduced as soon as possible.

721. Determine optimum sites for releasing rails.

A major component of a successful reintroduction program for the rail must be the suitability of sites where the birds are to be released. Criteria should be established and sites selected based on those criteria.

722. Determine methods for releasing rails.

The second major component of a successful reintroduction program for the rail must be the methods for releasing birds. The steps must be carefully planned to ensure maximum survival and adaptation to the wild environment.

723. Determine optimum sites for releasing kingfishers on Guam.

A major component of a successful reintroduction program for the kingfisher must be the suitability of sites where the birds are to be released. Criteria should be established and sites selected based on those criteria.

724. Determine methods for releasing kingfishers on Guam.

The second major component of a successful reintroduction program for the kingfisher must be the methods for releasing birds. The steps must be carefully planned to ensure maximum survival and adaptation to the wild environment.

725. Release rails and kingfishers on Guam.

Upon satisfying Tasks 721, 722, 723, and 724, when Guam rails and kingfishers are available, they should be released according to Tasks 722 and 724 respectively.

73. Study the feasibility of supplementing the Mariana crow population on Guam and implement when appropriate.

As the crow population is still extant on Guam, efforts should be made to supplement the population as soon as possible.

731. Investigate the feasibility of translocating crows from Rota to Guam in conjunction with snake control efforts.

The crows on Rota appear to be at normal carrying capacity. Relocation of crows to Guam while at the same time controlling snake predation around nest sites, may be an effective means of preventing the extinction of the Guam population.

732. Develop methods for introducing crows on Guam.

Methods should be developed for releasing either captive bred or translocated birds on Guam.

733. Determine optimum sites for releasing crows into essential habitat if appropriate.

A major component of a successful reintroduction program for the crow must be the suitability of sites where the birds are to be released. Criteria should be established and sites selected based on those criteria.

734. Release crows on Guam if appropriate.

Upon satisfying Tasks 731, 732, and 733, when crows are available, they should be released according to prescribed methods developed in Task 732, if appropriate.

74. Study feasibility of reintroducing Guam broadbills and bridled white-eyes to wild habitat, if appropriate.

These two taxa appear to be extinct. However, in the event that birds are found and a captive propagation program is successful, the feasibility of reintroduction into wild

habitat should be studied.

741. Determine optimum sites for releasing broadbills and white-eyes on Guam if appropriate.

A major component of a successful reintroduction program for the broadbill and white-eye must be the suitability of sites where the birds are to be released. Criteria should be established and sites selected based on those criteria.

742. Develop methods for releasing broadbills and white-eyes on Guam if appropriate.

The second major component of a successful reintroduction program for the broadbill and white-eye must be the methods for releasing birds. The steps must be carefully planned to ensure maximum survival and adaptation to the wild environment.

743. Release broadbills and white-eyes on Guam if appropriate.

Upon satisfying Tasks 741 and 742, when broadbills and white-eyes are available, they should be released according to prescribed methods developed on Task 732.

8. Develop a public awareness program for Guam and Rota's endangered species problem.

It is important that the public be kept fully informed of and educated about the endangered species problem on Guam and Rota.

81. Develop an endangered native bird conservation curriculum in cooperation with the Department of Education on Guam and in the CNMI.

The youth of Guam and Rota should develop an understanding of the cultural and natural history value of these endangered species.

82. Prepare a permanent endangered native bird display for use at fairs and meetings.

This would be an effective means of educating the public about endangered native forest birds.

83. Develop a cooperative education program for military personnel stationed on Guam.

Because military personnel are usually on Guam for less than two years at a time, the military needs to develop an

ongoing program of education for newly arriving personnel about local endangered species problems.

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IMPLEMENTATION SCHEDULE

The table that follows is a summary of scheduled actions and costs for this recovery program. It is a guide to meet the objectives of the Recovery Plan for the Native Forest Birds of Guam and Rota of the Commonwealth of the Northern Mariana Islands, as elaborated upon in Part II, Action Narrative Section. This table indicates the priority in scheduling tasks to meet the objectives, which agencies are responsible to perform these tasks, a time-table for accomplishing these tasks, and the estimated costs to perform them. Implementing Part III is the action of the recovery plan, that when accomplished, will satisfy the prime objective. Initiation of these actions is subject to the availability of funds.

Priorities in Column 1 of the following implementation schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Recovery Plan Implementation Schedule for Guam Forest Birds

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
1	341	Determine if any broadbills or white eyes remain on Guam	Ongoing	GDAWR	31	1	1	1	1	1	
1	311	Study breeding biology of Guam endangered birds	8	GDAWR	200	25	25				
1	3221	Develop rail breeding facility	3	GDAWR	452						
1	323	Develop zoo breeding facilities for up to 250 kingfishers	3	AAZPA	12						
1	342	Gather breeding biology data using surrogate species to develop captive breeding program for broadbills and white eyes.	5	GDAWR	30						
1	3222	Develop zoo breeding facilities on mainland for rails	3	AAZPA	15						
1	321	Capture Kingfisher and rails	3	GDAWR	45						
1	343	Develop zoo breeding facility for broadbills & white eyes if appriopiate	3	AAZPA	12						
1	344	Capture broadbills & white eyes if appriopiate	3	GDAWR	9						
1	312	Study breeding biology of Rota endangered birds	3	FWS-SE CNMIFWD*	6 30	2 10	2 10				

Recovery Plan Implementation Schedule for Guam Forest Birds

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
1	331	Study taxonomic relations between Rota & Guam crows	2	USFWS-RES* GDAWR CNMIFWD	6	3	3				
1	3322	Develop captive breeding techniques for crows at stateside zoos	3	AAZPA	30	10	10	10			
1	3321	Capture 2-4 pairs of crows on Guam	1	GDAWR	15		15				
		Cost Need 1 (Captive Breeding)			893	51	66	11	1	1	
1	411	Complete research into cause of decline on Guam	1	FWS-RES* GDAWR	15 15						
1	412	Investigate avian disease in CNMI	3	FWS-RES* CNMIFWD	180 75						
		Brown Tree Snake control									
1	43224	Encourage human exploitation of snakes	Ongoing	GDAWR	155	5	5	5	5	5	
1	43241	Inform public, military, & officials on hazards of snake introduction	Ongoing	CNMI	620	20	20	20	20	20	
1	43242	Implement stricter screening of cargo exported from Guam to Rota	Ongoing	GCQ* CNMI	310 310	10 10	10 10	10 10	10 10	10 10	

Recovery Plan Implementation Schedule for Guam Forest Birds

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
1	43243	Reduce snake populations in cargo dispatch areas	Ongoing	CNMI*	124	4	4	4	4	4	
				GAA	124	4	4	4	4	4	
				GAG	124	4	4	4	4	4	
				GCQ	124	4	4	4	4	4	
				USAF	124	4	4	4	4	4	
				USN	124	4	4	4	4	4	
1	43211	Study range and activity of snake	10	FWS-RES	200	20	20	20	20	20	
				GDAWR*	200	20	20	20	20	20	
1	43212	Study breeding of snake on Guam	10	FWS-RES	200	20	20	20	20	20	
				GDAWR*	200	20	20	20	20	20	
1	43214	Continue studies on feeding habits, density, & age structure	10	FWS-RES	200	20	20	20	20	20	
				GDAWR*	200	20	20	20	20	20	
1	43221	Investigate snake attractant and develop traps	8	FWS-RES*	264	33	33	33			
				GDAWR	264	33	33	33			
1	43222	Test repellent and snake barriers	8	FWS-RES*	264	33	33	33			
				GDAWR	264	33	33	33			
1	43223	Investigate chemical and biological control	8	FWS-RES	264	33	33	33			
1	43231	Reduce snake populations where birds are still found	Ongoing	USDA	140	5	5	5	5	5	
				GDAWR*	140	5	5	5	5	5	
1	43232	Snake proof nest sites where still remaining	Ongoing	USDA	1400	50	50	50	50	50	
				GDAWR*	1400	50	50	50	50	50	
1	43213	Determine origin of snake on Guam & intiate studies in its native range	3	FWS-RES	150	50	50	50			

Recovery Plan Implementation Schedule for Guam Forest Birds

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
1	43244	Develop methods to monitor for introduction of snakes on Rota	3	FWS-RES*	36	12	12	12			Intial efforts have begun
				CNMIFWD	36	12	12	12			
1	43233	Reduce or eradicate snakes from Guam	Ongoing	USDA	500	20	20	20	20	20	
				GDAWR*	500	20	20	20	20	20	
2	413	Monitor for disease	Ongoing	FWS-RES*	500	20	20	20	20	20	
				GDAWR	250	10	10	10	10	10	
				CNMIFWD	250	10	10	10	10	10	
2	4141	Restrict importation of exotic birds to Guam and Rota	Cont.	GDAWR*	125	5	5	5	5	5	
				CNMIFWD	125	5	5	5	5	5	
2	4142	Implement stricter screening requirements for import of birds	Cont.	GDAWR*	125	5	5	5	5	5	
				CNMIFWD	125	5	5	5	5	5	
2	4143	Prohibit release of exotic birds on Guam and Rota	Cont.	GDAWR*	125	5	5	5	5	5	
				CNMIFWD	125	5	5	5	5	5	
2	4144	Screen incoming aircraft and ships for disease vectors	Cont.	CNMICQ	125	5	5	5	5	5	
				GCQ*	125	5	5	5	5	5	
				USAF	125	5	5	5	5	5	
				USN	125	5	5	5	5	5	
2	42	Monitor pesticide usage & enforce laws	Cont.	GEPA*	125	5	5	5	5	5	
				CNMI	125	5	5	5	5	5	
2	431	Determine impact of dog & cat predation & impliment control	Cont.	GDAWR*	100	4	4	4	4	4	
				CNMIFWD	100	4	4	4	4	4	
2	433	Prevent importation & establishment of additional avian predators on Guam and Rota	Cont.	GDAWR*	100	4	4	4	4	4	
				CNMIFWD	100	4	4	4	4	4	

Recovery Plan Implementation Schedule for Guam Forest Birds

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
		Cost Need 2 (Control of exotic predators/diseases)			12146	694	694	694	455	455	
2	21	Conduct endangered bird surveys on Guam	Ongoing	GDDAWR	310	10	10	10	10	10	
2	22	Conduct Mariana crow survey on Rota	Ongoing	FWS-SE CNMIFWD*	5 90	3	3	3	3	3	
2	711	Study feasibility of introduction of Guam rail to Rota	3	FWS-SE GDAWR* CNMIFWD AAZPA	9 6 6 6						
2	712	Determine Optimum sites for releasing rails on Rota	1	FWS-SE GDAWR* CNMIFWD	2 10 3						
2	713	Develop methods for releasing rails on Rota	1	FWS-SE GDAWR*	2 10						
2	714	Release rails on Rota	5	FWS-SE* GDAWR	75 75	15 15	15 15	15 15	15 15		
2	722	Develop methods for releasing rails on Guam	3	FWS-SE GDAWR* AAZPA	6 6 6	2 2 2	2 2 2				
2	731	Study feasibility of relocating Rota crows to Guam	3	FWS-SE GDAWR CNMIFWD*	15 12 25		5 5 10	5 5 10	5 2 5		
2	732	Develop methods for introducing crows on Guam	3	GDAWR* AAZPA	24 24		8 8	8 8	8 8		

Recovery Plan Implementation Schedule for Guam Forest Birds

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
2	733	Determine optimum sites for releasing crows, if applicable	3	FWS-SE GDAWR*	12 12		4 4	4 4	4 4		
3	724	Develop methods for releasing kingfishers on Guam	1	FWS-SE GDAWR* AAZPA	5 5 5				5 5 5		
3	721	Determine optimum sites for releasing rails on Guam	1	FWS-SE GDAWR* AAZPA	10 10 10						
3	723	Determine optimum sites for releasing kingfishers on Guam	1	FWS-SE GDAWR* AAZPA	5 5 5						
3	725	Release rails and kingfishers on Guam	3	FWS-SE GDAWR*	30 30						
3	741	Determine optimum sites for releasing broadbills & white eyes on Guam if appropriate	1	FWS-SE GDAWR* AAZPA	4 4 4						
3	742	Develop methods for releasing broadbills & white eyes on Guam if appropriate	1	FWS-SE GDAWR* AAZPA	4 4 4						
3	743	Release broadbills & white eyes on Guam if appropriate	3	FWS-SE GDAWR*	24 24						
3	734	Release crows on Guam, if appropiate	3	FWS-SE GDAWR*	30 30						
		Cost Need 3 (Reintroduce forest birds on Guam)			1003	49	93	87	94	13	

Recovery Plan Implementation Schedule for Guam Forest Birds

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
3	61	Develop techniques & implement establishment of native forest when needed	Ongoing	GAG	140	5	5	5	5	5	
3	621	Determine effects of Sambar deer on essential habitat & control if necessary	10	GDAWR	70	2.5	2.5	2.5	2.5	2.5	
3	622	Determine impacts of feral goats & pigs on essential habitat & control if necessary	10	GDAWR	210	7.5	7.5	7.5	7.5	7.5	
3	63	Determine habitat needs of birds on Guam and Rota	3	CNMIFWD* GDAWR	40 15						
3	623	Determine impacts of insects on essential habitat & control if necessary	3	GAG* UOG	15 15	5 5	5 5	5 5			
3	624	Determine impacts of exotic plants on essential habitat & control if necessary	3	GAG* UOG	15 15	5 5	5 5	5 5			
3	64	Determine essential habitat for the Mariana crow on Rota	3	FWS-SE* GDAWR	18 18		6 6	6 6	6 6		
3	521	Evaluate essential habitats in southern Guam	1	FWS-SE GDAWR*	5 15		5 15				
3	522	Determine priority ratings	1	FWS-SE* GDAWR	3 3		3 3				Task 522 to be done in conjunction with task 521

Recovery Plan Implementation Schedule for Guam Forest Birds

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
3	65	Determine population demography criteria so relassification/ delisting criteria can be set	3	FWS-SE* GDAWR	9 9					3 3	
		Cost Need 4 Conduct research needed for management			615	35	73	47	27	21	
3	1	Develop Cooperative Agreement Between USFWS, CNMI, and Guam	1	FWS-FA* GDAWR CNMIFWD	5 5 5						
		Preserve and manage existing secure essential hab									
3	5111	Naval Facility	Ongoing	FWS-SE USN*	56 56	2 2	2 2	2 2	2 2	2 2	
3	51121	Coastal Forest, AAFB	Ongoing	FWS-SE USAF*	56 56	2 2	2 2	2 2	2 2	2 2	
3	51122	Conventional Weapons Storage Area, AAFB	Ongoing	FWS-SE USAF*	56 56	2 2	2 2	2 2	2 2	2 2	
3	51123	Northwest Field, AAFB	Ongoing	FWS-SE USAF*	56 56	2 2	2 2	2 2	2 2	2 2	
3	51124	Harmon Annex, AAFB	Ongoing	FWS-SE USAF*	56 56	2 2	2 2	2 2	2 2	2 2	
3	5113	Forest on former FAA property	Ongoing	FWS-SE USN*	56 56	2 2	2 2	2 2	2 2	2 2	
3	5114	Forest on NAVCAMS property	Ongoing	FWS-SE USN*	56 56	2 2	2 2	2 2	2 2	2 2	

Recovery Plan Implementation Schedule for Guam Forest Birds

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
3	5121	Anao Conservation area	Ongoing	GAG	56	2	2	2	2	2	
				GPR*	56	2	2	2	2	2	
3	5122	Pagat & Lumina Basin	Ongoing	GAG	56	2	2	2	2	2	
				GLM*	56	2	2	2	2	2	
3	5123	Puntan Dos Amates Park	Ongoing	GAG	56	2	2	2	2	2	
				GPR*	56	2	2	2	2	2	
3	5124	Falcona Beach	Ongoing	GAG	56	2	2	2	2	2	
				GPR*	56	2	2	2	2	2	
		Preserve and manage non-secure essentail habitat									
3	5131	Uruno Basin	Ongoing	FWS-SE*	56	2	2	2	2	2	
				GovGuam	56	2	2	2	2	2	
				GDAWR	56	2	2	2	2	2	
3	5132	Jinapsan Basin	Ongoing	FWS-SE	56	2	2	2	2	2	
				GovGuam*	56	2	2	2	2	2	
				GDAWR	56	2	2	2	2	2	
3	5133	Janum Basin area	Ongoing	FWS-SE*	56	2	2	2	2	2	
				GovGuam	56	2	2	2	2	2	
				GDAWR	56	2	2	2	2	2	
3	5134	Amantes Point area	Ongoing	FWS-SE	56	2	2	2	2	2	
				GovGuam	56	2	2	2	2	2	
				GDAWR*	56	2	2	2	2	2	
3	523	Secure management control of essential habitats in southern Guam	Ongoing	FWS-SE	56	2	2	2	2	2	
				GDAWR*	56	2	2	2	2	2	

Recovery Plan Implementation Schedule for Guam Forest Birds

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
		Develop public awareness program									
3	81	Develop Conservation curriculum	1	GDAWR* CNMIFWD	15 15						
3	82	Prepare endangered species display	1	GDAWR* CNMIFWD	5 5						
3	83	Develop a Coop education program for military personnel on Guam	1	FWS-SE GDAWR*	5 5						
		Cost Need 5 (Manage habitat)			2081	72	72	72	72	72	
		Total Yearly Costs			16738	901	998	911	649	562	

KEY FOR RESPONSIBLE AGENCIES

AAZPA = American Association of Zoological Parks and Aquariums.

CNMICQ = Commonwealth of the Northern Mariana Islands Customs and Quarantine.

CNMIFWD = Commonwealth of the Northern Mariana Islands Fish and Wildlife Division.

FAA = Federal Aviation Administration.

Recovery Plan Implementation Schedule for Guam Forest Birds

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments

FWS-ES = United States Fish and Wildlife Service, Region 1, Ecological Services.

FWS-FA = United States Fish and Wildlife Service, Region 1, Federal Aid.

FWS-RES = United States Fish and Wildlife Service, Region 1, Research.

FWS-SE = United States Fish and Wildlife Service, Region 1, Endangered Species.

GAG = Guam Department of Agriculture.

GCQ = Guam Customs and Quarantine Division, Department of Commerce.

GDAWR = Guam Division of Aquatic and Wildlife Resources, Department of Agriculture.

GEPA = Guam Environmental Protection Agency.

GOVGUAM = Government of Guam.

USAF = United States Air Force.

USDA = United States Department of Agriculture, Animal Damage Control.

USN = United States Navy.

* = Lead Agency

TOTAL COST = Project cost of task from start to completion.

APPENDICES

APPENDIX A

ESSENTIAL HABITAT

High priority essential habitats for the kingfisher, crow, white-eye, and broadbill in northern Guam have been specifically delineated in Figure 8 (High priority essential habitat for the Guam rail is not delineated). The area indicated in northern Guam represents some of the best habitat necessary for the survival of these endangered species. Long term survival and eventual recovery is dependent on maintaining population levels and distributions large enough to prevent deterioration of genetic variation through inbreeding. The density of birds in this northern portion of their essential habitat will depend primarily upon the level of control of the snake and/or other possible predators. Expansion of range and reestablishment of these species in essential habitats in southern Guam is anticipated if/as island-wide control of the brown tree snake proceeds. Only when the species have become reestablished in essential habitat at the population levels recommended can they be considered for downlisting.

The high priority essential habitats in northern Guam form a horseshoe-shaped strip of land extending north from Puntan Dos Amantes Park on the west coast, continuing around Ritidian Point, east to Pati Point, and finally extending south to Campanaya Point. This essential habitat consists of the land area between the beach and the cliffline, and in some areas, extending up tp 1 km inland. The Conventional Weapons Area (CWA) and Northwest Field (NWF) on Anderson Air Force Base are also included in this essential habitat.

Essential habitat for the four species consisting of former historical range in central and southern Guam also needs to be protected and managed. If the brown tree snake can be eliminated from these areas these habitats should be able to once again support their former assemblages and numbers of avian species. When this occurs, the listed species can truly be considered to have recovered from virtual extinction.

APPENDIX B

INDIVIDUALS CONTACTED DURING TECHNICAL REVIEW

Warren King
871 Dolly Madison Blvd.
McClean, VA 22101

Lou Sileo
National Wildlife Health Lab
U.S. Fish & Wildlife Service
6006 Schroeder Road
Madison WI 53711

Eugene R.P. Morton
Curator of Birds
National Zoological Park
Smithsonian Institution
Washington, D.C. 20008

*H. D. Pratt
4583 Downing Drive
Baton Rouge, LA 70809

Michael Bean
Chairman, Wildlife Program
Environmental Defense Fund
1525 18th Street, NW
Washington, D.C. 20036

John Groves
Curator of Amphibians & Reptiles
Zoological Society of Philadelphia
34th Street & Girard Avenue
Philadelphia, PA 19104

Larry Shelton
Curator of Birds
Philadelphia Zoological Garden
34th & Girard Avenue
Philadelphia, PA 19104

*J. Mark Jenkins
Dept. of Engineering Research
Pacific Gas & Electric Co.
3400 Crow Canyon Road
San Ramon, CA 94583

Eugene Kridler
103 Huckleberry Crest
Sequim, WA 98382

*Christian Grue
Fish & Wildlife Service
Patuxent Wildlife Service
Laurel, MD 20811

Thomas E. Lovejoy
Vice President for Science
World Wildlife Fund U.S.
1601 Connecticut Ave. NW
Suite 800
Washington, D.C. 20009

Thane K. Pratt
Div. of Forestry & Wildlife
1151 Punchbowl Street

Honolulu, HI 96813

Anne Maben
1708 Oak Avenue
Manhattan Beach, CA 90266

*Dianna F. Tomback
Department of Biology
University of Colorado
Denver, CO 80202

Phillip L. Bruner
Inst. Division of Biology
Brigham Young University
Laie, HI 96762

*Christine Shepard
Asst. Curator of Birds
New York Zoological Society
Bronx, NY 10460

Timothy A. Burr
Fish & Wildlife Biologist
Pacific Division
Naval Facilities Engineering Command
Pearl Harbor, HI 96860

Robert J. Shallenberger
U.S. Fish & Wildlife Service
Wildlife Research,
Migratory Birds

Matomic Building
171 H. Street, NW
Washington, D.C. 20240

Scott Derrickson
Curator of Birds
NZP Conservation Center
Front Royal, VA 22630

Celestino F. Aguon
1334 Kaihee Street, #101
Honolulu, HI 96822

*Colonel Billy E. Sachse
Headquarters, 43rd Combat
Support Group (SAC)
Andersen Air Force Base
APO San Francisco 96334

*Dr. Fern P. Duvall, III
DLNR/Forestry & Wildlife
Endangered Species Facility
P.O. Box 4849
Hilo, HI 96720

*John Engbring
U.S. Fish & Wildlife Service
P.O. Box 50167
Honolulu, HI 96850

Mike Scott
Idaho Cooperative Fish &
Wildlife Research Unit
College of Forestry

Moscow, ID 83843

*RADM Chauncey F. Hoffman
U.S. Pacific Fleet
Naval Forces Marianas
Commander, Naval Base Guam
FPO San Francisco 96630

*Thomas H. Fritts
Denver Wildlife Research Ctr
U.S. Fish & Wildlife Service
Museum of Southwestern
Biology
University of New Mexico
Albuquerque, NM 87131

*Barbara Schmitt
Fish and Wildlife Division
Dept. of Natural Resources
Commonwealth of the Northern
Mariana Islands
Saipan, M.I. 96950

Sam Marshall
New York Zoological Society
Bronx, NY 10460

*Comments received.

APPENDIX C

AGENCIES CONTACTED DURING AGENCY REVIEW

*CAPT. D. G. Metteer
U.S. Pacific Fleet
Commander Naval Forces Marianas
Commander Naval Base Guam
FPO San Francisco 96630

*Regional Director
National Marine Fisheries Service
Southwest Regional Office
300 S. Ferry Street, Rm 2016
Terminal Island, CA 90731

Richard J. Myshak
Regional Director
U.S. Fish & Wildlife Service
500 NE Multnomah Street
Suite 1692
Portland, OR 97232

*The Honorable Ricardo J. Bordallo
Governor of Guam
Office of the Governor
Agana, Guam 96910

James Branch
Administrator
Guam Environmental Protection Agency
P.O. Box 2999
Agana, Guam 96910

Elizabeth P. Torres
Director
Dept. of Agriculture
P.O. Box 2950
Agana, Guam 96910

*Henry Cruz
Director
Department of Commerce
Government of Guam
P.O. Box 2950
Agana, Guam 96910

*Colonel Billy E. Sachse
Headquarters, 43rd Combat Support Group (SAC)
Andersen Air Force Base
APO San Francisco 96334

*Director
U.S. Fish & Wildlife Service
U.S. Department of Interior
Interior Building, STOP 3256
18th & C Streets
Washington, D.C. 20240

*The Honorable Pedro Tenorio
Governor of the Commonwealth of the Northern Mariana Islands
Office of the Governor
Saipan, CM 96950

Nick Guerrero
Director
Dept. of Natural Resources
Capitol Hill
Saipan, CM 96950

John T. Palomo
Director
Dept. of Parks & Recreation
490 Naval Hospital Road
Agana Heights, Guam 96919

*Paul B. Souder
Director
Bureau of Planning
P.O. Box 2950
Agana, Guam 96910

Tony Chartarous
Director
Dept. of Land Management
Government of Guam
P.O. Box 2950
Agana, Guam 96910

Lloyd Osborne
Chief
Div. of Customs and Quarantine
Department of Agriculture
Government of Guam
P.O. Box 2950
Agana, Guam 96910

Arnold Palacios
Chief
Div. of Fish & Wildlife
Dept. of Natural Resources
Capitol Hill
Saipan, CM 96950

*Dr. Wilfred Leon Guerrero
Dean
College of Agriculture & Life Sciences
University of Guam
P.O. Box EK
UOG Station
Mangilao, Guam 96913

Edward W. Eckhoff
Division of Law Enforcement
National Marine Fisheries Svc.
U.S. Department of Commerce
P.O. box 3238
Agana, Guam 96910

Dale Rush
Animal & Plant Health
Inspection Service
U.S. Dept. of Agriculture
P.O. Box 8789
Tamuning, Guam 96911

*Harry T. Kami
Chief
Div. of Aquatic & Wildlife Resources
Department of Agriculture
P.O. Box 2950
Agana, Guam 96910

Carlos Noquez
Chief
Div. of Forestry and Soil Resources
Department of Agriculture
P.O. Box 2950
Agana, Guam 96910

*CDR J. R. Faunce
Civil Engineer Corps
U.S. Navy
Facilities Planning Dept.
Pacific Division
Pearl Harbor, HI 96860

* Comments received.